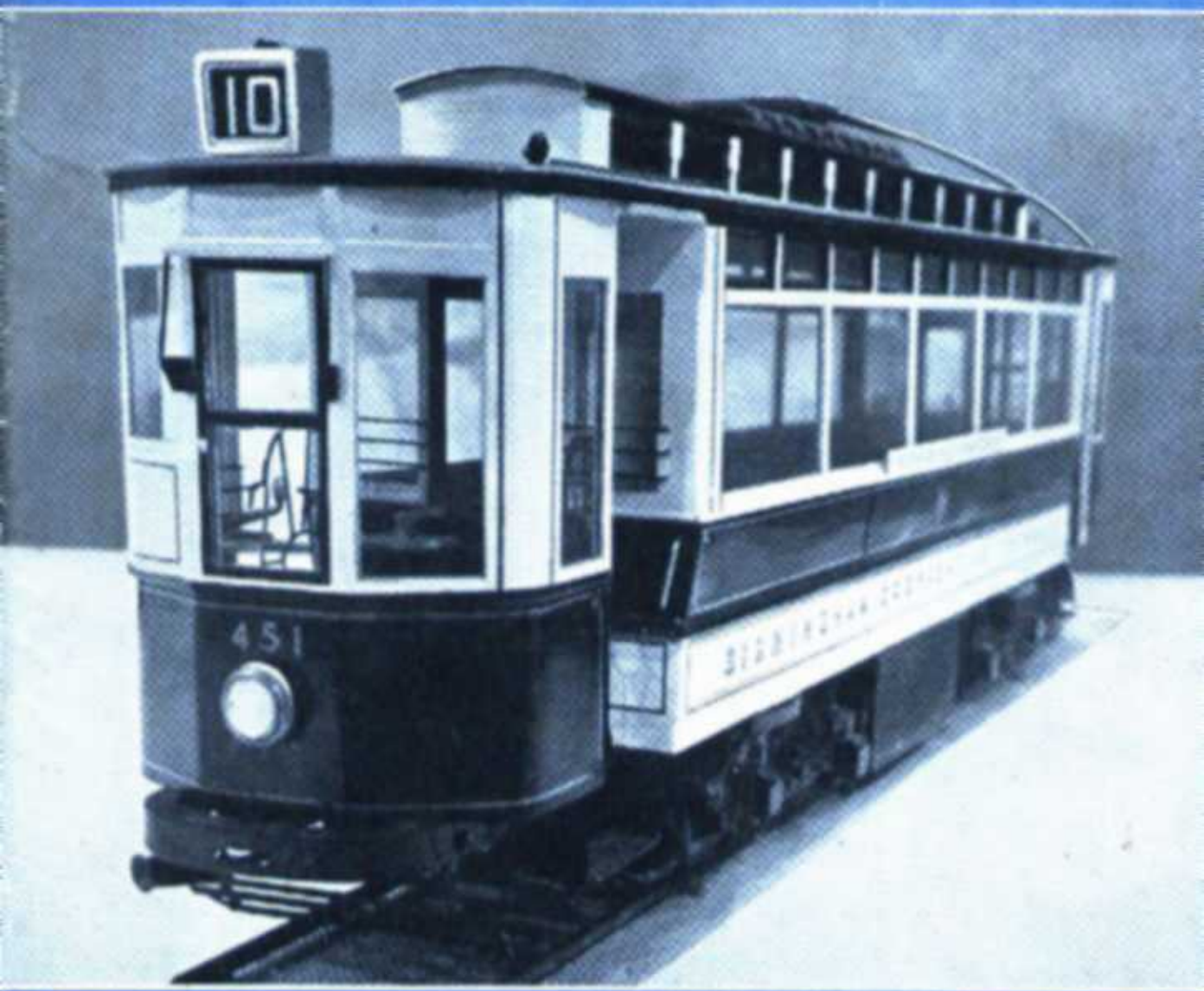
THE MODEL ENGINEER



IN THIS ISSUE

- A FODEN STEAM WAGON
- TOOLING OUT SMALL BORES
- L.B.S.C.'s "NETTA"
- VEE BELT CONVERSION OF AN M.L.I
- HOW THE MODEL FOR THE NEW T.V. SYMBOL WAS MADE
- A PERIOD-MODEL TRANSIT CASE
- CLAMPING DEVICES

JANUARY 28th, 1954
Vol. 110 No. 2749

9D

THE MODEL ENGINEER

EVERY THURSDAY

Volume 110 - No. 2749

JANUARY 28th - 1954

ESTABLISHED 1898

PERCIVAL MARSHALL & CO. LTD. 19-20 NOEL STREET · LONDON · W·1·

CONTENTS

SMOKE RINGS	83
A CRAFTSMAN'S STRONGHOLD Where the New T.V. Symbol was wrought in Wood and Metal	84
SUPPRESSORS FOR ELECTRIC POWER TOOLS	86
MAKING A SURFACE GAUGE AND A RULE HOLDER	87
A PERIOD-MODEL TRANSIT CASE	90
"WODEN" ENGINEER'S TOOLS	92
L.B.S.C.'s "NETTA" A North-Eastern T-class "Mitey" Hauler in Five Gauges	93
A FODEN STEAM WAGON	98
THE ALLCHIN "M.E." TRACTION ENGINE	100
TOOLING OUT SMALL BORES	103
CLAMPING DEVICES	104
READERS' LETTERS	105
INTERESTING I.C. ENGINES	107
QUERIES AND REPLIES	108
VEE BELT CONVERSION OF AN "M.L.2"	109
WITH THE CLUBS	110

Our Cover Picture

It cannot be denied that whenever some familiar mechanical, or transport device which, for many years, had been regarded as a matter of course, eventually becomes obsolete, model makers immediately turn their attention to it and devote their time and energies to reproducing it in miniature. The most striking instance of this, in recent times, is the electric tramcar, the numbers of which have declined and are still declining to a marked extent. The interest now shown in modelling electric trams is far greater than ever before, apparently for no other reason than the threatened extinction of the prototype.

The car depicted on this week's cover is a very fully detailed working model for 2⅜-in. gauge, made by Mr. Peter Hammond of the Manchester Model Railway Society, and it won the Championship Cup at the society's recent exhibition.

SMOKE RINGS

Exhibition in Bombay

WE HEAR that the eighth exhibition organised by the Bombay Society of Model Engineers, and held at the end of November, was very well attended and proved a great success. It was opened by Mr. S. K. Patil, M.P., President of the Bombay Pradesh Congress Committee, who inspected the exhibition and congratulated the society's Chairman, Mr. M. P. Polson, and the members on the excellence of the exhibits and the arrangements.

It is satisfactory to note that some British trade exhibits were sent out through the Model Engineering Trade Association, six different firms being represented; this was the first time that anything of the kind had been arranged for the model engineering hobby in India.

The Bombay S.M.E. has been in existence for 14 years, against difficulties that are unknown to British model engineers. Its success is largely due to the indefatigable efforts of Mr. Polson.

Any Work in Hand ?

WE OFTEN think that in the many model engineering societies all over Britiain there must be a great deal of work, either completed or in hand, which will never be seen or heard of by the majority of model engineers. There are, in all probability, several reasons why this should be so; often the builders of models dislike the idea of publicity, or have neither the time nor the desire, nor even the ability (so they seem to think) of writing a description for us to publish. In some cases, we are prepared to send a representative for the purpose of examining and writing-up a nice model that might not otherwise have become known to anybody outside its particular locality, or club.

We suggest that, in every society, there is somebody capable of writing an interesting story about some outstanding piece of work by a fellow-member; and we would like to see that story, especially if it is illustrated by some good photographs and necessary drawings or sketches. We therefore present this hint to club-members generally, who will know better than we do which of their fellow-members could be delegated to do the job. And we would add that, to us, this hint should be well worth bringing to the attention of the many club press relations officers who might see in it a golden opportunity for giving publicity to any nice piece of work they know of.

We would like especially to hear from any readers engaged in the construction of models being described in our pages, such as Westbury's steam engines, "L.B.S.C.'s" *Titfield Thunderbolt*, Hughes's "Allchin" traction engine, and the like. Any notes and, if possible, photographs recording the progress of such work would be especially welcome; and it is certain to be of interest and even of use to other readers.

Electric Locomotive Trials

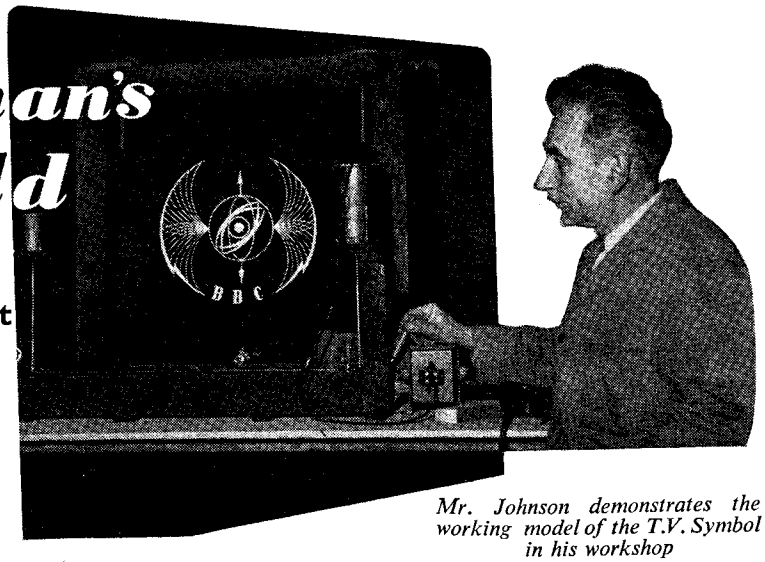
THE FIRST of seven 2,500 h.p. six-axle electric locomotives under construction for the Manchester-Sheffield-Wath electrification scheme recently started trial running between Dukinfield and Crowden. These locomotives, which each weigh over 100 tons, will be used for hauling heavy freight and passenger trains.

The mechanical parts of the locomotives are being built at the Gorton locomotive works of British Railways (Eastern Region) and the electrical equipment is being supplied and erected by Messrs. Metropolitan-Vickers Electrical Co. Ltd.

The bodies of the locomotives, which house the electro-pneumatic control equipment, starting resistances and auxiliary machines, are mounted on two three-axle bogies, each of which is equipped with three 415 h.p. motors. Draw-gear and buffers are carried on the bodies. The locomotives are fitted with electrically heated boilers for passenger train heating, and with equipment for regenerative braking.

A Craftsman's Stronghold

..... Where the new T.V. Symbol was wrought in wood and metal



Mr. Johnson demonstrates the working model of the T.V. Symbol in his workshop

TO Mr. J. Johnson, of Shepherds Bush, it means little that millions of people every day see one of his models on the television screen. The physical interpretation of Mr. A. Games's clever design for the new TV symbol has been regarded by Mr. Johnston as "just one more interesting job." And every job is interesting, to this remarkable craftsman.

Most people see the symbol as a beautiful, mystic, and strangely fascinating device. Such, indeed, it is. Both the designer and the craftsman have produced something in which artistry and mechanics combine to please the eye and mind, as well as convey a message.

Mr. Johnson himself is a symbol, in a way. . . . He is, in fact, a very important symbol, for he represents the indispensability of the craftsman in an age of mechanisation and mass-production. This we shall see, as we come to consider the character and the work of this man who brushes aside any reference to his own abilities, yet is quick to stress the importance and dignity of the skilled specialist in any field.

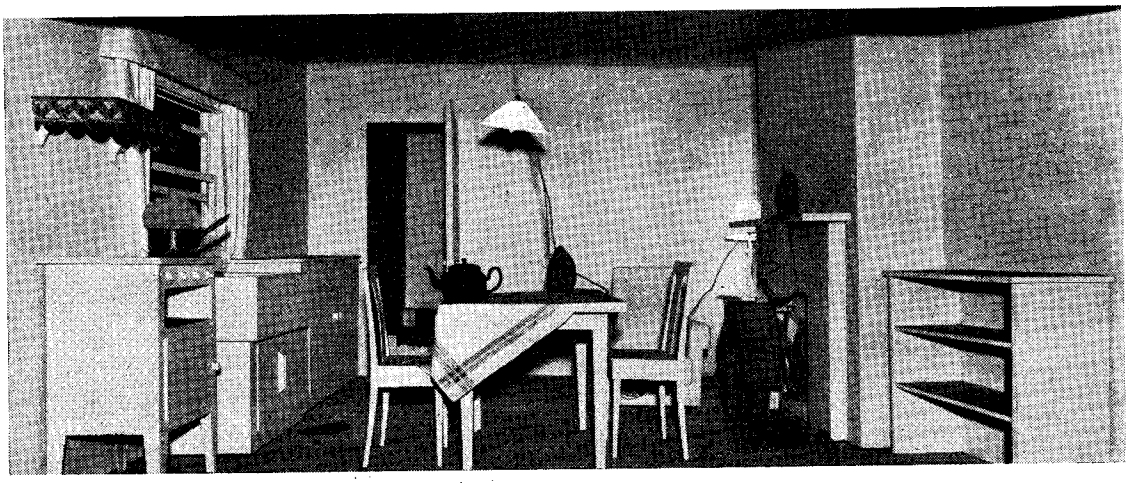
How did he become a professional model maker? It is difficult to say. It is perhaps not even strictly correct to call him a model maker and simply leave it at that. A good deal of his work is full-scale, and sometimes it is larger than life.

Mr. Johnson's father was one of the old school of coachbuilders—those who might lovingly form the spokes of a carriage wheel in iron-hard oak or ash, or perhaps trim the neat metal mudguards with fine unblemished hide—and he, the son, quite naturally took up the craft, although in its more modern form, in the motor industry.

Decline of Craftsmanship

With one thing and another, however—and not least the 1914 war, in which he had served as an infantryman—young Johnson did not see a great future in the coachbuilding business. "Metal bodies were on the way in, and the craftsman was on his way out" as he puts it. He turned his attention to fine wood-carving, to art, and various forms of sculpture, and, happy in his little workshop at home, found work coming to his hands for profit. His £25 gratuity was soon spent, and there were some bitter struggles at first, but he came out on top, and set himself well on the road towards the independence and creative fulfilment which he enjoys today.

Perhaps typically, I found him in his spacious, tidy workshop installing a new heating stove. The old slow-combustion affair, he explained,



In connection with a Home Office exhibit, a model of a room was made to demonstrate poor electrical installations. (With acknowledgments to the Central Office of Information)

had wasted fuel and had shed thick dust all over his tools and work as the weeks went by. He is well accustomed to installation and structural work of this kind. His 19th-century house was what he calls a "dump" when he went into it, but he has rebuilt a good deal of it himself and today it is a place where anybody would be proud to live.

I looked around the shop. On three sides there are drawers containing all manner of materials. There are, in fact, 250, and Mr. Johnson seems to know what is in every one of them ! In one section of the building is a store of fine timbers. There is a stock of metal sheet and sections, and various plastics such as Perspex, nylon, acetate, etc., in sheet and rod form. Everywhere there is evidence of a fine ability in model-making. The hull of a ship, the facade or interior of a building, tiny furniture and figures, aircraft wings and fuselage structures, etc.

Mechanics of the T.V. Symbol

On one of the benches was the model of the symbol itself—a masterpiece of design and mechanism. Briefly, this is an intricate "motif," the centre part of which has a complex movement in two planes. The main problem, apart from making the parts, and devising the means of lighting and movement, was that of suspending the assembly so that it would appear quite unsupported when seen on the viewing screen.

A large wood frame had to be made to support the main components—motor and gearbox, special projectors, etc., and of course, the symbol itself. This was the easiest part of the work, as Mr. Johnson is a skilled joiner. The symbol—made up painstakingly from hard brass and steel—was suspended in the middle of the main vertical frame by means of piano wire, tensioned by adjusting screws in the frame, in the same manner as cycle spokes. Tensioning was necessary because the symbol had to be rigid enough to take the drive without any shudder or other movement.

Soft soldering was employed for the attachment to the wires, as well as for making up the symbol itself. Any heat greater than that necessary for soft soldering would have caused distortion of the delicate parts.

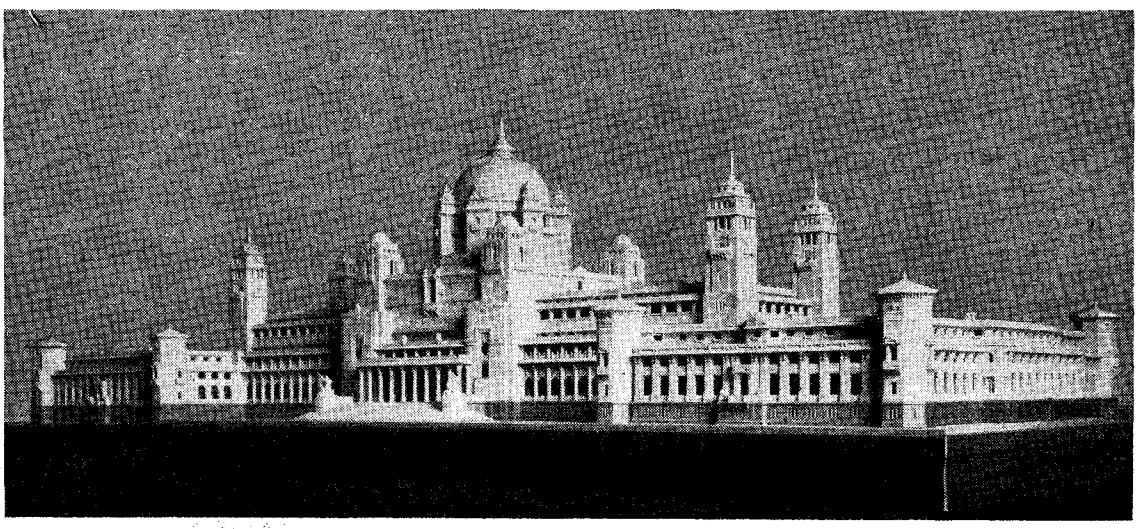
The main drive for the rotation of the components in the centre of the symbol is taken from an ex-aircraft 24-volt motor which has a suitable reduction gear, bringing the spindle speed down to 24 r.p.m. There is a further reduction at the base of the upright spindle to the motif, this being by worm and wheel, so that the final speed is only four revolutions per minute. Speed had to be very low, to be in correct relationship to the requirements of the camera. The vertical drive is taken to a miniature differential box, behind the hub of the device. This box had to be small enough not to show, and the biggest gear wheel is of $\frac{3}{8}$ in. diameter. The box is designed to give movement at right-angles to the main vertical drive, to the two "eyes" of the design, which move in opposite directions—i.e. clockwise and anti-clockwise. There is also a ring, which moves round the outside of the eyes horizontally (i.e. with a vertical axis) and this is, of course, driven by the main vertical spindle.

Precision Timing

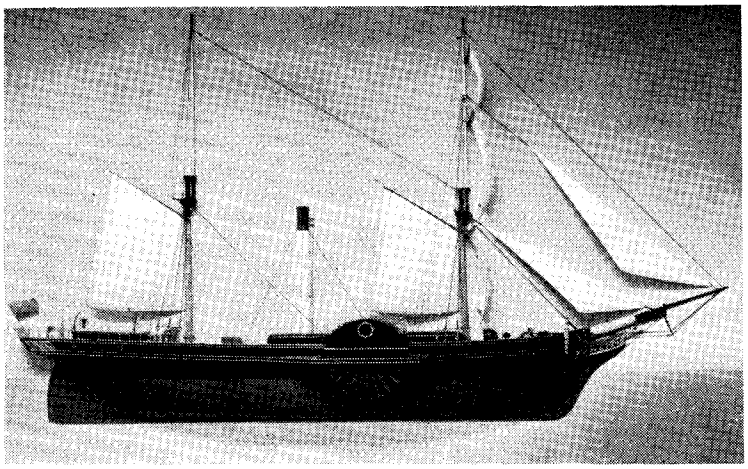
The timing of the three main moving parts had to be very carefully determined, whilst all clearances had to be kept to the minimum. The symbol is in flat white, and all the "invisible" parts are in dead black. At an early stage, Mr. Johnson found it necessary to use poster colour for the white, instead of the cellulose finish which he had initially applied, and the altered thickness of the paint film demanded a modification of the clearances !

Precision engineering was also required in an endeavour to avoid backlash which might have resulted in jerky motion of the model. At the periphery of the six-inch-diameter ring, for example, any erratic movement of the tiny spindle or gear would be greatly exaggerated.

Another drive is taken outwards from the base of the vertical spindle and divided, with three sets of bevels, to rotate two light-projector units. No optical magnification of the light-source is employed, but the peep-hole principle provides the required projection. Each projector consists of a globe, a revolving inner cylinder pierced with a continuous series of crescent-shaped slits, and a stationary outer cylinder



This remarkable model of the Jodhpur Palace was made for the architects



Mr. Johnson was responsible for this model of the P.S. Sirius, *the prototype being the first vessel to cross the Atlantic under continuous steam power, the passage taking* 16½ *days. The vessel was wood-built by Menzies of Leith in* 1837

with an aperture in the form of a small replica of one of the " wings " of the symbol. Twelve-volt globes are used.

I was shown a number of other assignments, past and present. One of the current ones is a steering-head locking device for cycles. The inventor's prototype was neat and effective but such a thing has to be translated into terms of quantity production, and this is an instance where Mr. Johnston reveals himself as a development engineer, because he simplifies the design, making it easy to produce and to fit, yet without the slightest loss of efficiency. His development drawings cause him no trouble. He is equally proficient as an artist in colour or black-and-white, in two dimensions or three.

Much of his work is in connection with architectural designs, and with fairs and exhibitions. Sometimes he has created vast bas-relief works for the decoration of buildings. In one such case the giant panels, in 6 ft. sections, filled his storage shed, while awaiting transport. Many are the scale models he has made for architects and public authorities, including the ornate and magnificent Jodhpur Palace, a complete modern dockyard installation, and a great new hospital enterprise. He has done many works in connection with geological and archaeological records and research, including those which were on view at the Festival of Britain Exhibition. His ship models have been assessed as " up to museum standards " by notable authorities. But all is grist for the mill, and he showed me pictures of some very tempting whisky bottles . . . beautifully-finished wooden ones, to serve as patterns for commercial production in glass.

The Old and the New

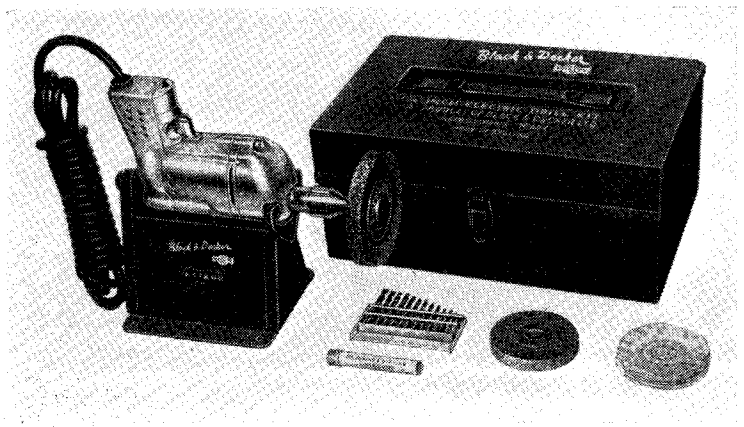
I left with an indelible mental picture of Mr. Johnson's past, present and future, as symbolised by three pieces of equipment in his workshop. One of these—representing the past—is more an assembly than a single item. Perhaps the word " unit " fits the case. It consists mainly of a sawbench, a simple wood-turning lathe, and a planing machine. The sawbench is on the left of the lathe and the planer on the right, whilst the lathe-bed consists of widely-spaced timber longitudinals, so that there is ample clearance for turning large sections.

The present is represented by a comparatively modest engineer's lathe which does not quite match up to Mr. Johnson's exacting standards these days, and the future—or perhaps the present, by the time this is written—is a new, gleaming Myford Super 7, in its protective wrappings. I can imagine, however, that the woodworking machinery and those countless craftsman's hand-tools will live in happy harmony with the sleek, shiny newcomer for many years to come.

SUPPRESSORS FOR ELECTRIC POWER TOOLS

THE small electric power tools which are adaptable to a wide variety of workshop uses have attained a well-deserved popularity among our readers, but a serious deterrent to their employment in many cases is the interference with radio and television reception caused by the high-speed universal motors which drive them. Many queries have been received from users, regarding the possibility of fitting suppressors to the motor circuit of these tools, and we are therefore, pleased to learn from Messrs. Black and Decker Ltd., Harmondsworth, Middlesex, that all their Handy-Utility ¼-in. drills and 5-in. sander-polishers are now fitted with built-in suppressors which completely eliminate radio and television interference. Users can operate these tools without risk of spoiling the entertainment of their own families or neighbours.

Messrs. Black and Decker also announce reductions in the prices of the ¼-in. Handy-Utility Drill, and the ¼-in. Drill Kit (as shown in the photograph) which should still further increase the popularity of these useful appliances.



MAKING A SURFACE GAUGE AND A RULE HOLDER

By "Duplex"

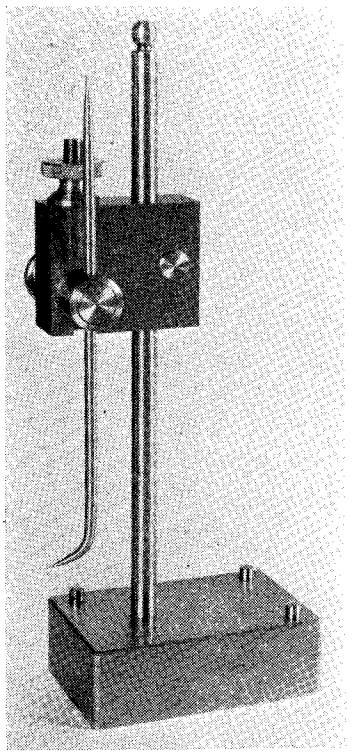


Fig. 1. *The finished surface gauge*

A SURFACE gauge, for marking-out work on the surface plate or for setting components in the lathe to centre height, is an almost essential part of the workshop equipment.

Constructing a tool of this kind not only saves expense, but also provides a useful exercise in turning and fitting for those making a start in the workshop.

Making a kit of tools used to be the common practice among engineering apprentices; this, besides having instructional value, affords an opportunity for exercising individual skill and craftsmanship.

In the surface gauge, here described, the customary pivoted joint for the pillar has been omitted and, although this detracts somewhat from the full usefulness of the appliance, it also lessens the difficulty of construction for those making a first attempt.

As will be seen in Fig. 2, a vertical pillar is firmly fixed in a heavy base *A*, and for making coarse adjustments the head *B* can slide on the pillar, but is locked by a clamp-bolt *E*. The scriber itself is carried in the clamp mounting *D*, and this assembly has a limited range of vertical movement, in order to provide a means of fine adjustment when the plunger *C* is moved upwards or downwards by turning the knurled finger-nut.

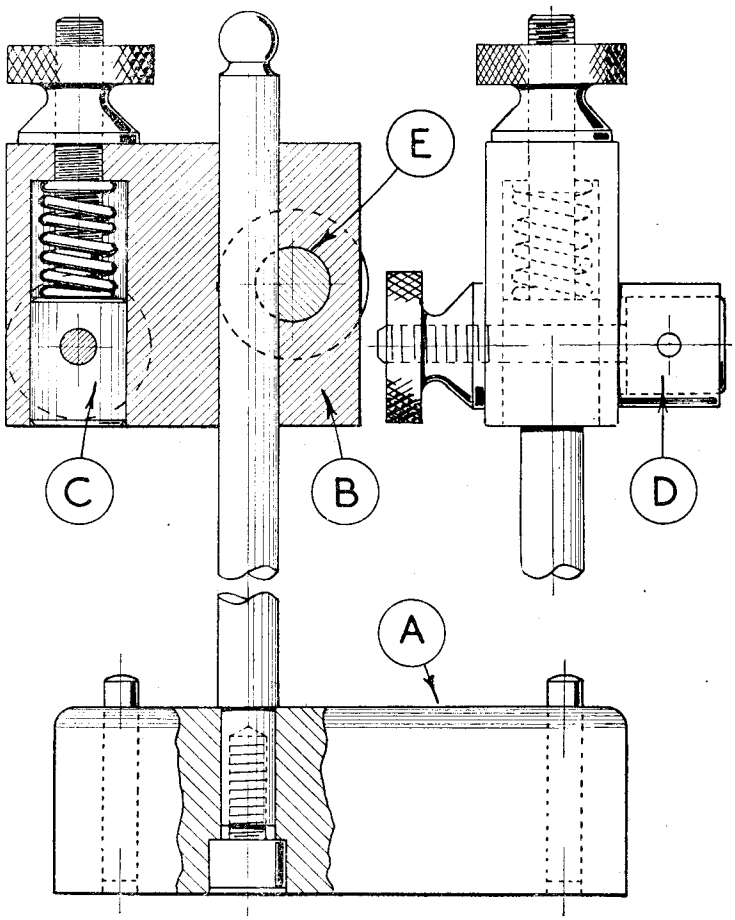
Right: *Fig.* 2. *A—the gauge base; B—the sliding head; C—the fine-adjustment screw; D—the scriber clamp-bolt; E—the head clamp-bolt*

The Base A

To afford stability, the base is formed from either a heavy iron casting, or a block of mild-steel.

The material should be filed flat and square, and the under surface can quite well be faced in the lathe with the work held in the four-jaw chuck; needless to say, the finished base must be able to stand on the surface plate without rocking, and any correction found necessary can be carried out with a hand-scraper.

Three $\frac{3}{16}$ in. diameter, steel register pins are made a push-fit in



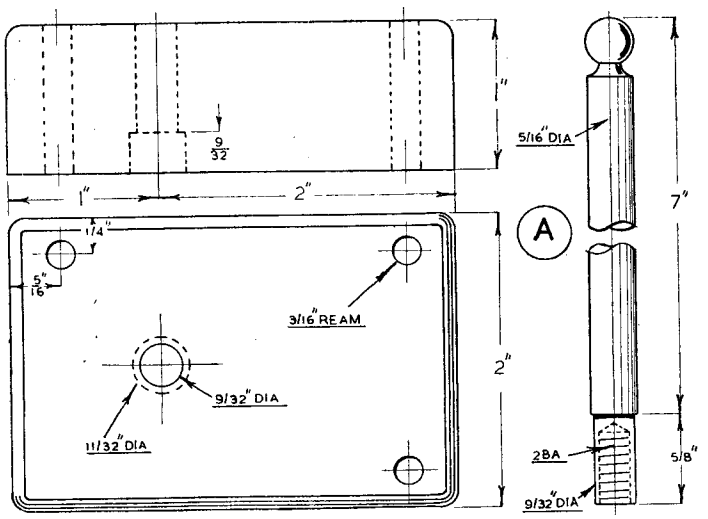
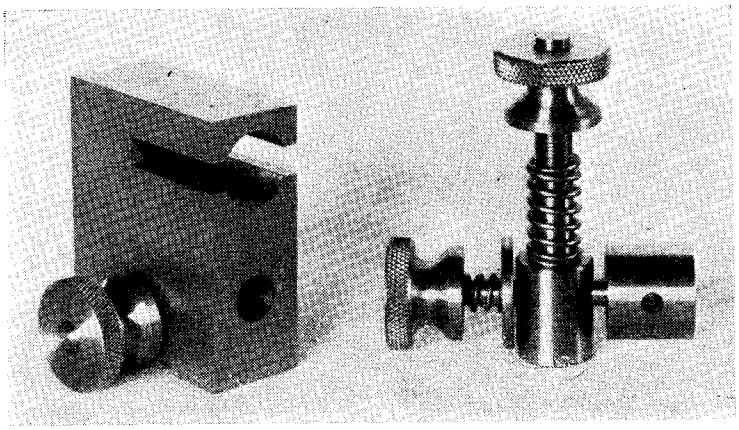
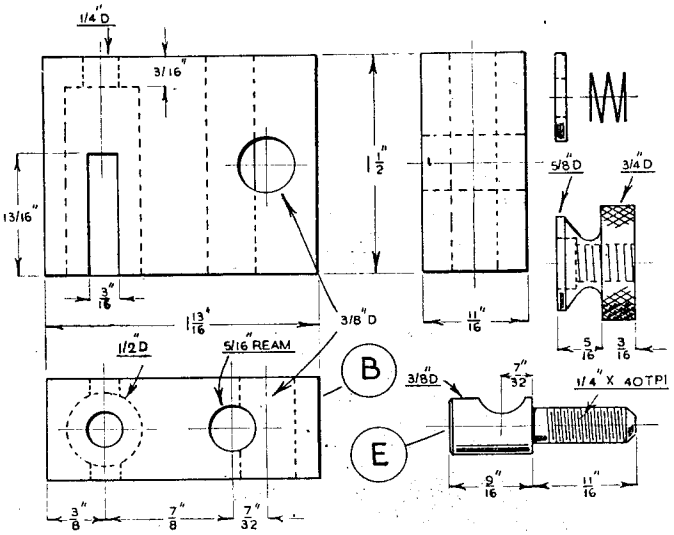


Fig. 3. The gauge base and pillar

Right: Fig. 5. The fine-adjustment screw and scriber clamp assembly



Below: Fig. 4. The gauge head and clamp-bolt



the base; these serve to locate the surface gauge against a guide edge, such as one of the shears of the lathe bed.

The pillar can be made from a straight length of silver-steel rod, and should be turned and shouldered to a close fit in the base, where it is secured in place with an Allen cap-screw, inserted from underneath and having its head sunk below the surface.

The Head B

The head is clamped to the pillar by the half-moon draw-bolt *E*. To make this bolt, the head is first accurately marked-out in accordance with the drawing, and the $\frac{3}{8}$ in. diameter bolt hole is then drilled. The bolt itself is then made, but is left over-length so that it can be threaded at both ends and nutted securely in place in the head part.

Next, the $\frac{5}{16}$ in. diameter hole for the pillar is drilled and reamed so that, at the same time, the half-moon recess is machined in the bolt. The bolt can then be cut off to the finished length. The head is now step drilled to take the adjustment-bolt *C*, and the bore is cross-slotted by filing to accommodate the clamp-bolt *D* carrying the scriber. This completes the work on the head, except that, if the pillar bore in the head and the pillar itself are lightly lapped to remove any surface irregularities, a smooth sliding action of the head will be ensured, but the spring fitted to the pillar clamp-bolt will keep the head from falling while height adjustments are being made.

The Fine-adjustment Bolt C

This fitting enables the height of the scriber point to be accurately adjusted after the head has been clamped to the pillar. The head of

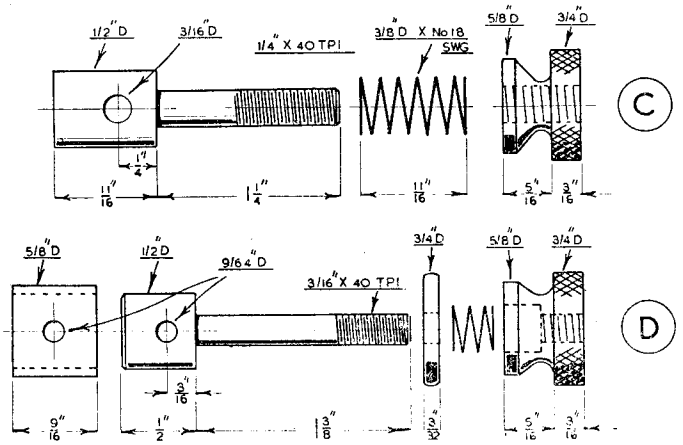


Fig. 6. The adjustment screw and scriber clamp

the bolt is turned to a close sliding fit in the bore already drilled in the head, and the spring fitted must be strong enough to move the bolt downwards for the full extent, when the knurled adjusting-screw is slackened.

The Scriber

To enable the surface gauge to be used for a wide range of marking-out work, the 9/64 in. diameter scriber is made to the shape shown in Fig. 1. Both ends of a straight length of rod are finely pointed, by gripping the work in the chuck and, with the lathe running at high speed, a coarse and then a smooth file is used to shape the points. After the ends of the rod have been hardened and then tempered to a light straw colour, the scriber is again mounted in the lathe for smoothing and sharpening the points with an oilstone slip.

When setting the height of the surface gauge scriber for marking-out work on the surface plate, the rule used for this purpose must be positioned vertically in order to avoid taking a false reading. The small rule holder illustrated in Fig. 7 is convenient to use and, again, is quite easily made from a short length of $\frac{3}{4}$ in. square mild-steel bar.

The material is first filed or machined flat and square, and the hole for the spring-fixing screw is then drilled and tapped.

Next, two holes for the register pins are drilled, on a line exactly at right-angles to the under surface of the base.

These pins can either be made from $\frac{1}{16}$ in. diameter silver-steel rod, or taper pins can be fitted after the holes have been taper-reamed.

When using the holder, the rule is pushed under the spring and up against the register pins; the holder is then placed on the surface plate and the rule is pressed downwards until its lower edge bears evenly on the surface plate.

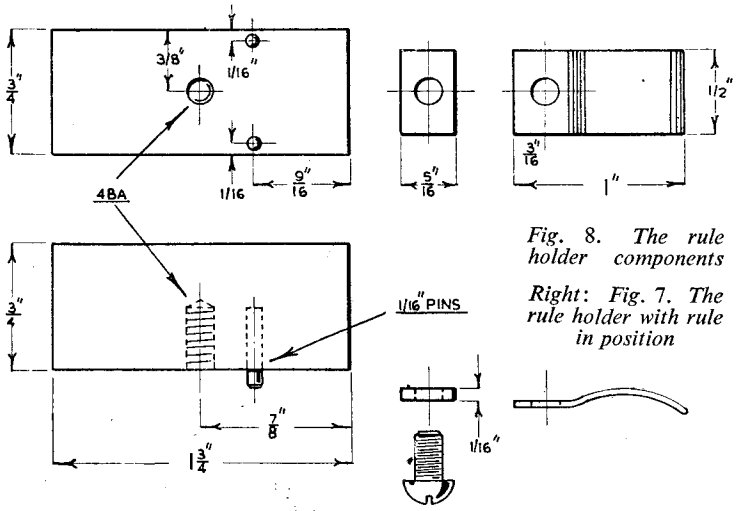
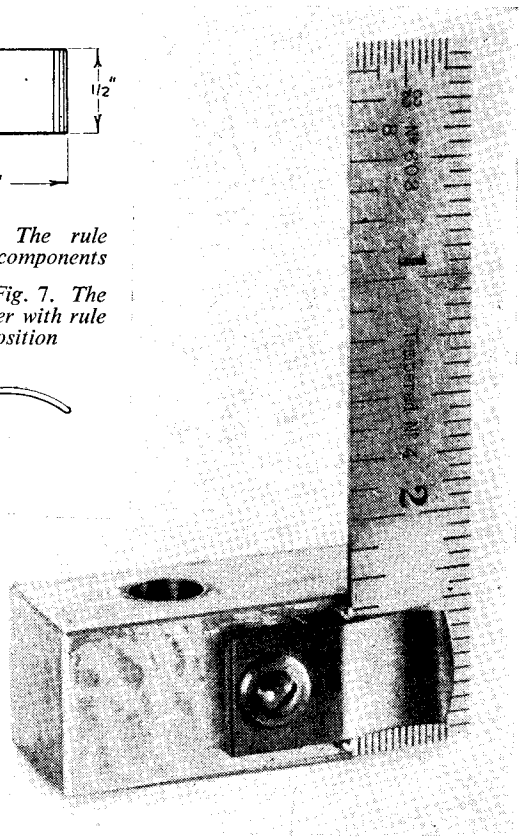


Fig. 8. The rule holder components

Right: Fig. 7. The rule holder with rule in position



The Scriber Clamp-bolt D

This bolt locks both the scriber and the bolt *C* after the final height adjustment has been made.

The bolt head, with its $\frac{5}{8}$ in. diameter sleeve mounted in place, should be cross-drilled for the scriber in a cross-drilling jig of the kind described in a previous article. If this drilling has been accurately carried out, the scriber should slide into place, even after the sleeve has been turned through an angle of 180 deg.

A PERIOD-MODEL TRANSIT CASE

By J. W. Moon

SINCE completing my first attempt, a 3½-in. gauge locomotive, *Rainhill*, and showing it at exhibitions hundreds of miles from its home base in Middlesbrough, the question of transporting the model has presented difficulties. The chief problem was due to my being unable to accompany the model, and, on three occasions, British Railways supplied the answer.

No doubt, many excellent examples of model engineering have yet to be seen in public because of the problem of transporting them long distances unaccompanied by the owner. Additionally, time and cost can also deter the enthusiast with modest means. It is, therefore, with a view to encouraging model engineers to bring their models off the shelf despite such difficulties, that an attempt is being made in the following notes to describe how such problems can be overcome. Another deterrent which must be mentioned, is the possible damage to the model during transit. It must be admitted that *Rainhill* was indeed a virtual "guinea pig" so to speak, during the course of solving the problems arising.

The initial experiments of constructing a transit-case which would eventually prove a safe means of transport and come through the inevitable knocks en route, cost *Rainhill* many a dent and subsequent touching up with the paint brush. The chimney usually ended up anything but perpendicular and caused me to muse upon how it appeared on reaching the different exhibitions. Needless to say, the early experiments with the transit-case cannot have been complete failures, since the model travelled to and from six widely separated exhibitions, and on each occasion gained an award.

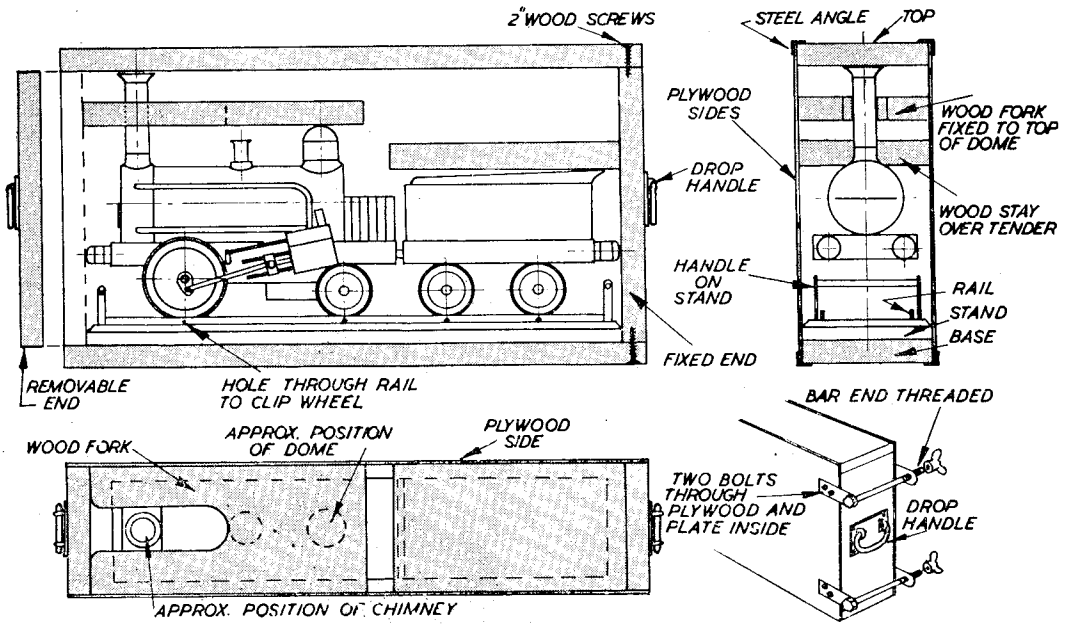
Originally, the idea of exhibiting anywhere almost made me grow cold at the mere contemplation; therefore, first thoughts were to construct a case simply to house the model and assist in keeping it free from dust and corrosion. Prior to constructing the transit-case, the model was already *in situ* on a mahogany stand derived from the remains of an old table top.

At that time the stand was made merely for the purpose of having something upon which to place the model, and a couple of lengths of Gauge "O" rails pinned to the stand with chairs sufficed. Such rails were found to be useless when sending the model "per passenger train," and after the first such trip to and from an exhibition, ¼-in. of mild-steel bar was substituted. So the case was actually built, stage by stage round this stand, the latter having an important bearing on ease of access in and out of the case, to the ultimate joy of society members preparing for an exhibition, with very little time to spare.

Having assisted in pre-exhibition work of that nature, I resolved that simplicity and ease of access should be the keynote. At the same time, weight had to be borne in mind, without sacrificing the strength of the case, because the cost of transport cannot be ignored by the man with little spare cash.

The materials used were 3-ply wood cut into two sheets for the sides, and a length of 6 in. × 1 in. pine used for the base, top and ends, plus two pieces of 6 in. × 1 in. for internal strengthening, and a quantity of 1 in. × 6-gauge countersunk wood screws, eight 2-in. × 8-gauge ditto, and two drop handles.

For a case of this type, nails should not be used. Wood-screws



are essential, due to the method of construction, apart from contributing to a job which will most certainly not fall assunder at the first good knock. Measurements are, of course, according to the size and type of model.

In this instance, the case is to accommodate a period locomotive.

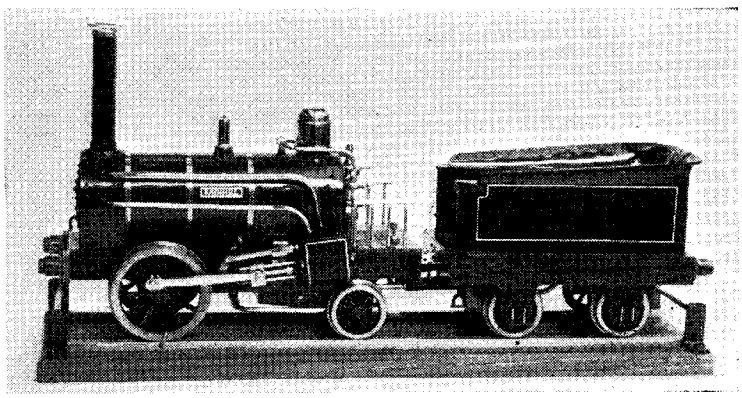
The stand upon which the model is secured, slides in and out of the case, and must be made the length of the model from rear to front buffers at their outside extremity. The width in my case is 6 in., but will vary according to the width of the locomotive.

Using $\frac{1}{4}$ in. mild-steel square bar for rails, drill each length to take countersunk wood screws at 6 in. intervals, and ensure that the rails are completely rigid and firmly screwed into the stand. However, prior to finally screwing the rails down, drill a $\frac{1}{8}$-in. hole parallel with the centre of each wheel of the model. These holes through the rails take a clip which will fasten the wheels to the rails. Another important point connected with the wheels and rails is to ensure that when the model is standing on the rails, very little side movement between the wheel flanges is permitted.

The type of clip or fastening is left to the ingenuity of the model engineer, for a piece of suitable wire passing through the hole and round the wheel (provided that it is a spoked wheel) will suffice. No doubt, other methods of ensuring that the locomotive is soundly secured to the stand can be contrived, but it is of prime importance that the wheels cannot move on the rails. Solid wheels, obviously, cannot be clipped to the rails; the alternative is to secure the axles to the stand and still keep the wheel treads hard down on to the rails. This can be achieved by screwing wood blocks to the stand, for the purpose of taking clips to swing over the axles. These blocks, in addition to preventing any upward movement, also obviate any forward movement when the model is on the stand.

On no account use rails which are pinned by the small chairs associated with Gauge "O" layouts, for a knock will loosen the chairs and subsequently leave the model swinging from side to side in the crate. In the case of *Rainhill*, the chimney took the strain returning from the "M.E." Exhibition of 1952, due to using rails pinned to the stand instead of heavier rails screwed down with wood screws.

Handles, to carry the stand and model *in situ*, were items which I later discovered to be an asset



screwed at each end of the stand, the front handle being particularly useful and essential in withdrawing the model from the case. The handles also serve to ensure that the model once fixed in position on the stand remains untouched (see photograph above of model on stand.

Having completed the stand essentials and secured the model in position, bearing in mind that the stand should be made presentable, in view of it always being on show with the model, prepare to construct the case.

First cut two pieces of 6-in. × 1-in., each 2 in. longer than the stand. Place the model already *in situ* on its stand upon one of the 6-in. × 1-in. pieces leaving 1 in. showing past the stand at each end. Take the second piece and put it on the chimney top in line with the base piece. Measure between base and top, then cut two pieces of three-ply wood for each side, the measurements being, of course, equal to the length of the pieces of 6-in. × 1-in. and height overall from base to top. Screw one of the 3-ply sides to the top and base with 1-in. × 6-g. countersunk wood screws, at not more than $3\frac{1}{2}$ in. centres.

Now, having one side, the top and base screwed together, stand the model in this and cut a piece of 6-in. × 1-in. pine for the rear end to fit between top and base. Ensure that this piece butts up to the stand end prior to screwing through with countersunk wood screws at least 2 in. in length. Do not attempt to screw through the 6-in. × 1-in. before drilling some pilot holes, otherwise splitting will result, particularly in view of the screws being very close to the end (see drawing).

Next, cut a piece of 6-in. × 1-in. for the front end, and leave this end loose, as it is eventually used to gain the only means of access into the case. A piece of 6-in. × 1-in. timber should now be cut to fit over the tender which, in the case of *Rainhill*, is lower than the engine. This prevents any upward movement when the model is in the case. Another piece is cut to rest on top of the dome, but is also cut out to fit round the chimney; but let the chimney float so to speak, in the fork of wood, by cutting out enough to ensure that the chimney cannot hit the sides of the fork, during transit (see drawing of top view of interior). Screw these two pieces into position through the plywood side already fixed; then, before screwing on the remaining side, glue pieces of green baize cloth to the parts of the case which touch the model. Actually, the only part to which it was found necessary to glue padding was over the tender top and rear.

Where the dome and chimney top come in contact with the case, it is better to leave bare wood to assist in sliding the model from the case. In any event, brass parts unpainted do not take any harm.

The remaining plywood side can now be screwed into position, not forgetting to mark the position of the two internal stays over the tender and engine so that they can be easily located when screwing. The latter internal stays are essential not only to add strength to the case by making the sides rigid, but the front one which takes the chimney prevents the loose end moving inward when the case is complete.

Fix a drop handle at each end of the case, then make four lugs (two for each side) from 3/32 in. mild-steel plate and drill for $\frac{1}{4}$-in. mild-steel round bar. Bolt the lugs in position with countersunk bolts from the inside of the case, but first cut a piece of $\frac{1}{16}$-in. mild-steel plate to take the bolt heads for each lug to prevent the bolts pulling through

the plywood sides when the nuts outside are tightened.

Next, take two pieces of ¼-in. mild-steel round bar and nut one end of each permanently. The other end of each bar must be threaded to take a nut or wing-nut, whichever is preferred. Reference to the drawing of the front end of case will make the arrangement clear. I found, from experience, that another essential is a piece of steel angle screwed to each corner. A length of bed angle cut into eight pieces, about 3 in. long, proved admirable for the purpose.

Prior to painting the case, preferably in black, try sliding the model fixed to the stand in and out, and should this operation prove difficult due to binding along the case sides, ease the stand edges by running a plane along.

However, do not overdo the planing should it be necessary and cause a sloppy fit, for the ultimate success rests chiefly with the snug fit of the stand in the case plus the fastening of the wheels to the rails screwed into the stand. A rubbing along the stand edges with sandpaper will suffice if the binding is not too severe.

Having ensured that the model slides in and out nicely, push in the loose end. This, of course, fits into the front end near the chimney, and should be a reasonably tight fit when in position. Movement of the loose end inward, is prevented by the end of the forked stay at the top and the end of the stand at the bottom. The drop handle serves the purpose of pulling on when removing the end to gain access to the model.

When the model is in the case and the loose end pushed into position, put the bolts through the lugs which are situated above and below the drop handle on both sides of the case, and tighten up the wing-nuts. If the foregoing instructions have been followed, the case can then be placed upside down, stood on end, or placed on either side without any danger of the model moving to cause damage. Furthermore, the model is easily removed and replaced.

It is advisable to denote the top by painting " This End Up " on the top of the case. On mine, one side bears the word " Fragile " and the other side carries " Handle With Care " plus name and address on the top, all painted in white to make a more or less permanent job of the words. Up to the present the transit case for *Rainhill* has taken the model by rail to places as far apart as London, Grimsby and Manchester in addition to Newcastle and Sunderland by road.

Incidentally, the case and stand together weigh 13 lb. and the model 26 lb. making a total of 39 lb.

The overall measurements of the case are: Length 2 ft. 2 in., width 6¼ in. and height 1 ft. 2 in.

A heavier model will require more solid sides than plywood, unless bracings are placed round the exterior. It is suggested that the same principles of construction should apply, however, for models up to 3½-in. gauge.

A period model with tall chimney calls for the two internal wood stays due to the height; but a model of a later design would eliminate the necessity for these stays due to the reduction in height from base to top of the case.

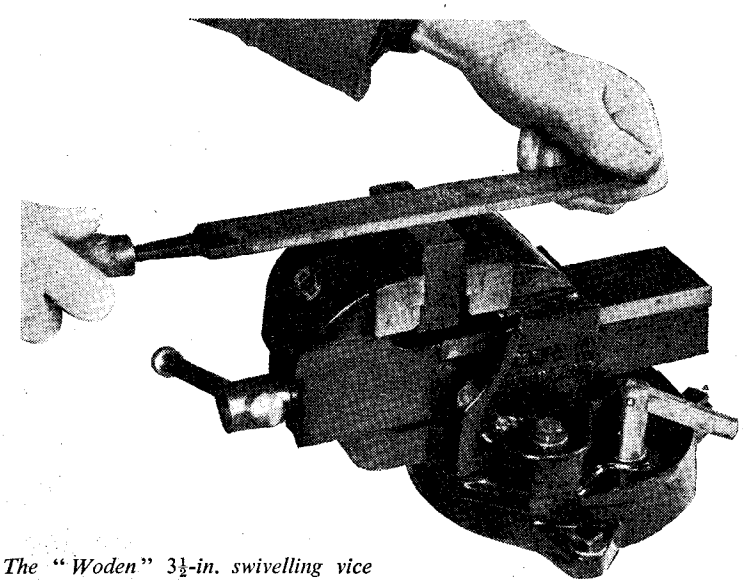
The cost of wood and screws came to about 12s. 6d., although the drop handles are extra to that amount; mine came off an old chest.

"WODEN" ENGINEER'S TOOLS

THE range of tools manufactured by The Steel Nut and Joseph Hampton Ltd., Woden Works, Wednesbury, Staffs, is well known to engineers, woodworkers, builders and other skilled trades. It includes a wide variety of devices for cramping, clamping and holding work both on the bench and in other locations, all of robust design and proved quality. Among these, the " Woden " vices have earned a specially high reputation; they are made in types and sizes to suit all classes of amateur or industrial work, from the " Minor " 2⅛-in. table vice, equipped with mounting clamp, to the 12-in. floor vice weighing nearly half a ton. This range also includes woodworking, machine and pipe vices.

We have carried out a prolonged test of one of the latest " Woden " 3½-in. swivelling parallel vices in the " M.E." workshop, and find it an accurate and rigid appliance, well suited to withstand the wear and tear of the heaviest work likely to be encountered in the home workshop. The swivelling feature is extremely useful, and as seen in the photograph, the locking bolt is readily accessible and easily operated; it locks the base of the vice quite firmly with moderate tightening. In common with all other " Woden " vices except the very light types, hardened renewable jaw inserts are fitted; the jaws are designed to provide exceptional strength, in conjunction with well-designed guides to the sliding surfaces.

" Woden " tools are obtainable from tool dealers throughout the country, and are moderately priced in view of their sound practical qualities.



The " Woden " 3½-in. swivelling vice

L.B.S.C.'s

"NETTA"

A NORTH-EASTERN T-CLASS "MITEY" HAULER IN FIVE GAUGES

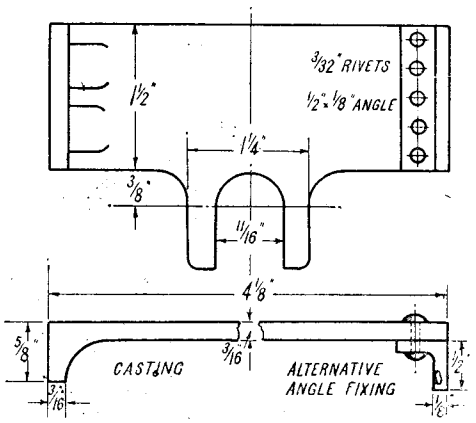
AS promised in the last instalment, here are the details of the pump and frame stays for the rest of the quins. Those for the 2½-in. gauge engine are made in practically the same manner as those for the 3½-in. gauge job, but only one hole need be drilled in the frame stay. As all dimensions are given in the drawing there will be no need to dilate on the construction; the location of both the stays is shown in the drawing of the 2½-in. gauge frames. I might mention here that limitation of space prevents the reproduction of some of my drawings, as big as we would like to see them; but wherever possible, they will be full size, or in some cases larger, on the blueprints.

The pump and frame stays for the 5-in. gauge locomotive, differ slightly in appearance from the smaller ones. The lower edge of the pump stay is slotted out like a hornblock opening, instead of being drilled and tapped. This will take a pump similar to the type described for the *Maid of Kent*, with a square flange attachment, and a studded gland which couldn't be screwed through a tapped hole. This type of pump is also readily removable without disturbing the stay, should the need arise. Construction can be the same as in the smaller sizes, but I strongly recommend castings for the 5-in. job, as they entail less work; I guess I must have been born lazy! As a matter of fact, the pump body and valve-box could be cast integral with the stay, but the machining is easier if separate castings are used. Note that the frame stay has a rectangular opening, which should be beaded on a casting, similar to full-size practice. Cast stays for the 5-in. engine can be machined up in the same way as those for the 3½-in. job; if a vertical slide is available, it isn't necessary to have a very big endmill or slot drill, as the slide allows two or three cuts to be taken, simply by adjusting its height.

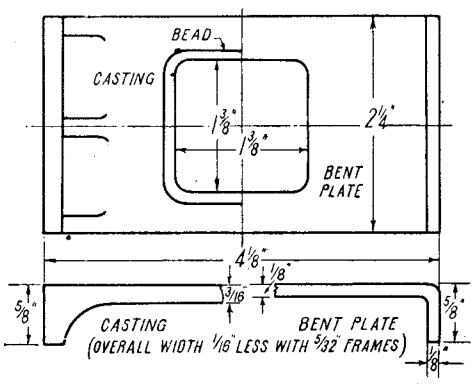
Plain rod stays, as shown in the detail drawing, will be quite O.K. for the baby quin. Put one in the location of the pump stay on the larger engines—this baby doesn't need a "feeding-bottle"—and one at the bottom of the frame approximately ½ in. behind the centre of driving axle. This will be well clear of the valve-gear eccentrics. Another can be set at the top of the frames, exactly above the driving axle. Same applies to the gauge "1" quin; but those builders who prefer plate stays can use them, made of 16-gauge plate, with bent flanges, similar to those illustrated for the 3½-in. gauge engine, and to half the dimensions. The overall width should be 1 5/16 in.; and 1/16-in. or 10-B.A. screws, spaced approximately at half the distances shown for 3½-in. size, can be used for erection.

Axle Bushes for Gauges "O" and "1"

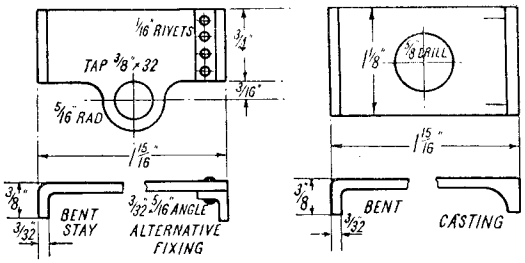
For the baby quin, I recommend plain bushed holes for the axles to run in, and springing isn't essential. This simplifies matters very considerably; no joints are needed in the coupling-rods, and if the engine is to be used on a road with sharp curves, the flanges can be turned off two pairs of the coupled wheels, without any fear of the engine derailing through the flangeless wheels running off the rail heads. Indoor "scenic" lines are usually level enough to render springs unnecessary on a locomotive of this type. If the gauge "1" engine is to be used on a scenic indoor line, same thing applies; but if intended for outdoor use as a live passenger hauler, a job she will do quite easily, simple sprung axleboxes should be used, as shown in the illustration. The whole lot can be made from a piece of bronze, gunmetal, or hard brass bar, 5/8 in. wide 3/16 in. thick, and a little under 5 in. long. A groove should be milled or planed down each side, just wide and deep enough to allow the boxes to slide



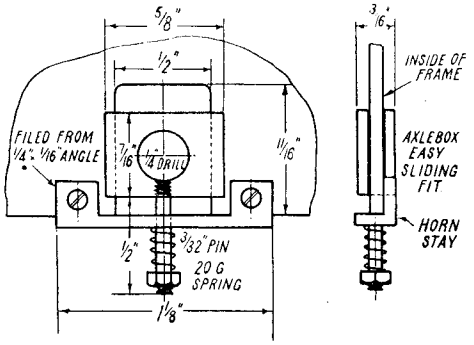
Pump stay for the 5-in. gauge engine



Frame stay for the 5-in. gauge engine



Pump and frame stays for the 2½-in. gauge engine

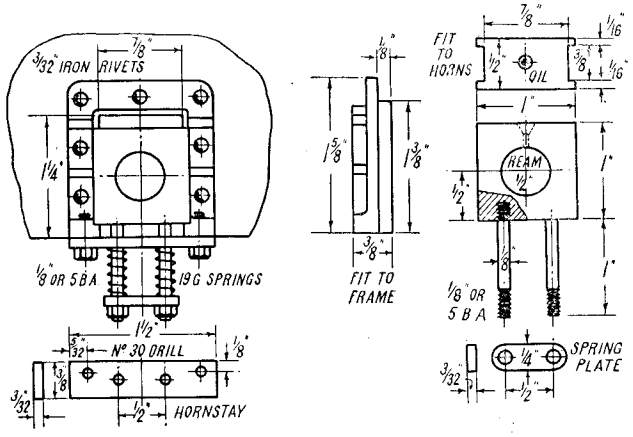


Spring axlebox for the "1" gauge engine

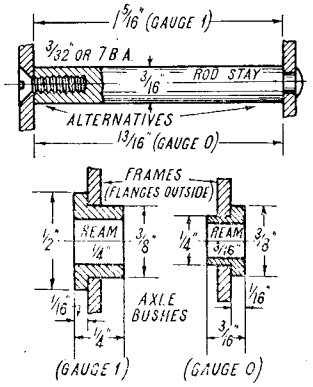
easily in the horn openings in the frames; they shouldn't be slack. The piece of bar is then either chucked in the four-jaw, and eight $\frac{7}{16}$ in. lengths parted off, to form the boxes, or they can be sawn off to full length, and then chucked separately in the four-jaw and faced both ends to correct length. Fit each box separately, and mark both the box and the opening, so that the boxes can always be replaced as first fitted. In the middle of each box, on one side of the engine, drill a No. 30 hole, and use each box as a jig to drill its opposite mate on the other side, temporarily clamping them together, in the way I have shown, and a No. 40 hole drilled in the bottom for the spring pin. Put the axleboxes in place in the frames, and attach the hornstays underneath them, by $\frac{1}{16}$-in. or 10-B.A. screws. The hornstay flanges go inside the frames. They can be riveted with $\frac{1}{16}$-in. rivets, if desired, as the axleboxes shouldn't need taking out again, until the engine needs a complete overhaul. Drill and tap the axleboxes for spring pins, through the holes in the hornstays, which will ensure correct

Hornblocks and Axleboxes for 2½-in. Gauge

The three larger locomotives have proper hornblocks and axleboxes, similar to those used in full size, but simplified. I have arranged matters so that "standard" types of hornblocks can be used; either castings, which save extra pattern-making, and keep the price down, or the hot-pressed or die-cast type, which requires no machining. In the 2½-in. gauge size, the latter are the same as those specified for previous



Hornblocks and axleboxes for the 3½-in. gauge engine

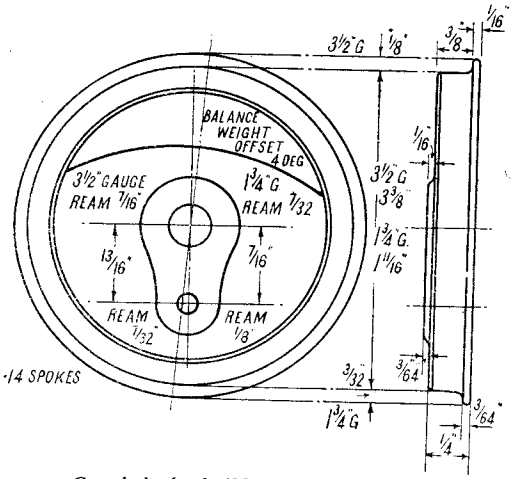


Frame stay and bush details (gauges "1" and "O")

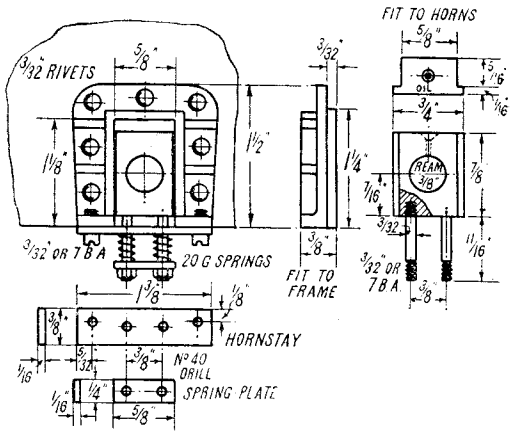
already explained many times. Replace boxes in frames, and test each pair with a piece of $\frac{1}{8}$-in. round silver-steel, which is usually straight and true; or the No. 30 drill itself can be used. If the bit of steel, or the drill, lies square across the frames, open out the holes to $\frac{1}{4}$ in. clearing. If not, correct as explained farther along.

The hornstays are made from $1\frac{1}{8}$ in. lengths of $\frac{1}{4}$-in. × $\frac{1}{16}$-in. angle, with the centre part filed as alignment and easy working. Jam the box tight up against the stay; make a countersink with a No. 40 drill through the hole in the hornstay, follow with No. 48, and tap 3/32 in. or 7 B.A. The spring pins are made from 3/32 in. silver-steel, or 13-gauge spoke wire as shown; the springs are wound up from 20-gauge tinned steel wire, around a piece of the stuff used for the pins, and secured by ordinary commercial nuts.

engines of similar gauge described in these notes, dimensions being checked from samples sent by both Reeves and Kennion, as made to my earlier drawings. They should fit the openings in the frames exactly; if they don't, a slight application of a file to the flanges will teach them good manners. Rivet them to the frames as shown; the flanges should come flush with the outside of the frame. The rivet holes should be countersunk on the



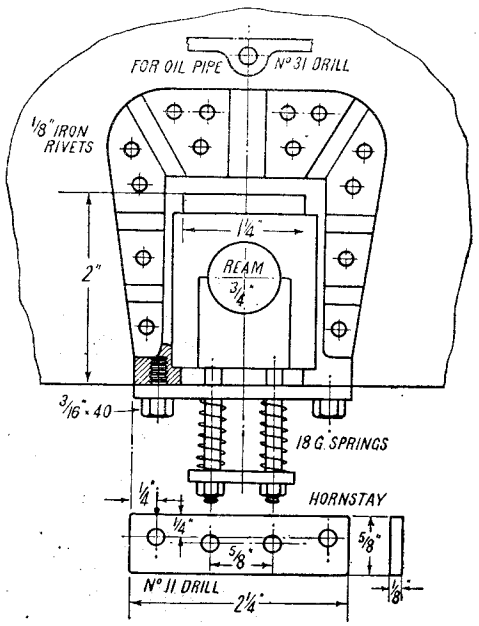
Coupled wheels (3½-in. and 1¾-in. gauges)

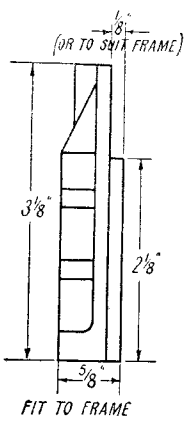


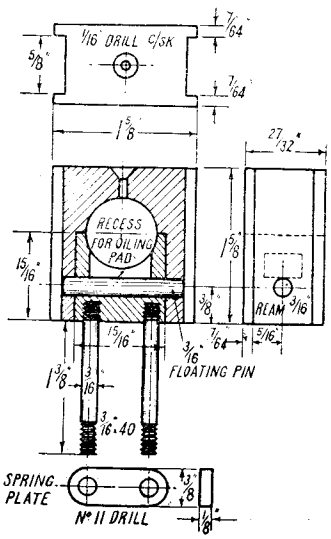
Hornblocks and axleboxes for the 2½-in. gauge engine

outside, the rivets hammered well home into the countersinks, and filed off smooth. If the frames haven't been erected, they can be clamped " back to back," or " inside out " as the kiddies would say, after the hornblocks have all been attached, and the openings for the axleboxes in each pair, cleaned out with a file, so that a piece of ⅝-in. bar will slide betwéen the jaws without shake. If the frames are already fixed, just rivet on the hornblocks, smooth separately, using a wide smooth file bearing against the hornblock on the opposite side, and test for squareness with the piece of bar.

If castings are used, and they happen to be smooth, and only a shade larger than finished size—I have some here now that are only a weeny bit inferior to the pressed kind—they also can be finished with a file, as above. If they need machining, the job can easily be done in the lathe, if a vertical slide is available. Bolt the casting to the slide, flange outward, using a rectangular washer, or small piece of ⅛-in. steel, a shade smaller than the opening in the frame, viz.: a bare ¾ in. × 1¼ in. for the 2½-in. gauge engine. Drill a ¼-in. or 9/64-in. hole in the middle for a bolt to pass through and attach it to the slide. Set the casting exactly vertical or horizontal, it doesn't matter which, and put a ⅜-in. endmill or slot drill in the three-jaw. Feed the casting on to the cutter with the top-slide; and by manipulating the cross-slide and vertical-slide handles separately, the contact part of the hornblock can be cleaned up dead true, without cutting away any of the flange. I did mine in that fashion before I had a vertical milling machine. The





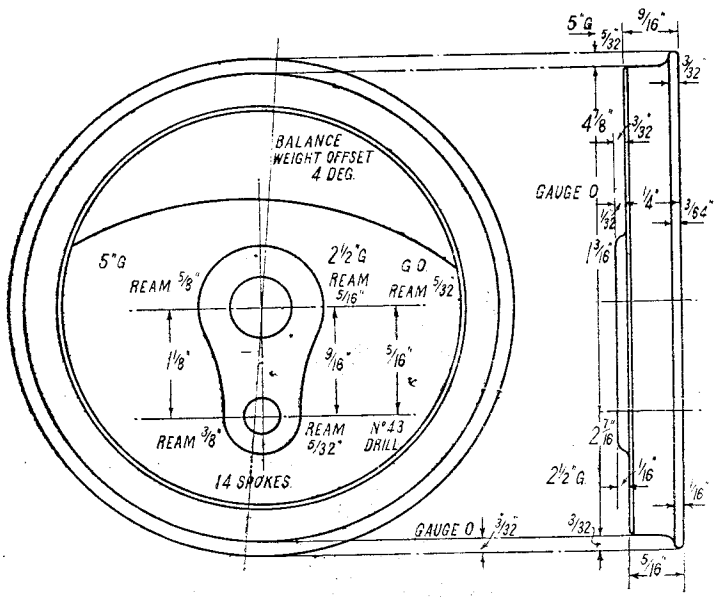


Hornblocks and axleboxes for the 5-in. gauge engine

whole business was described in full detail, with explanatory illustrations, in the *Tich* serial. Incidentally, beginners keep on asking me if there is any likelihood of the *Tich* notes being reproduced in book form, same as *Maisie*. That is a question that our good friends the publishers only can answer, as I "signed the contract" for it long since. In that serial, everything connected with the building of a small locomotive was described in the fullest detail, with all necessary sketches and drawings; so look up your back numbers !

The axleboxes for the 2½-in. gauge engine can be made from ⅜-in. × ¾-in. bar; the best material would be cast or drawn bronze or gunmetal, but hard brass would do at a pinch. The alloy known in the trade as "screw-rod," will not resist wear, and should not be used. If a milling-machine is available, a piece about 8 in. long can be rebated on both sides, milling away $\frac{5}{16}$ in. width to $\frac{1}{16}$ in. depth, as shown in the plan view of the axlebox. It should then slide easily in the hornblock jaws without being sloppy. If cast material is used, smooth off the front and back; saw off eight pieces a little under 1 in. long, chuck each in four-jaw, and face the ends to finished length. If the lathe will take the piece of bar without too much overhang, the boxes can be parted off to finished length. Fit each box separately to a hornblock, and mark them to prevent mixing up, as mentioned above. Mark off the centres on one side, and drill No. 30, using either drilling-machine or lathe, as it is important that the holes go through dead square. Use each box as a guide to drill its opposite mate, as described for the gauge "1" engine, then put all the boxes in their proper slots, and test for squareness with a bit of ⅛-in. silver-steel. If this doesn't lie dead square across the frames, correct the hole in the box which is "out," with a rat-tail file. Put a No. 12 drill through the corrected hole, and the one in the opposite box, and test again with a piece of $\frac{3}{16}$-in. silver-steel. When all are O.K. open out the holes with a 23/64-in. drill, replace boxes in frames, and put a ⅜ in. parallel reamer through the holes, moving the boxes up and down the horns while reaming. This allows the axles to run quite freely, when the boxes move up and down, as the engine runs over a bit of rough road, or through crossing frogs. Note that the axleboxes for the 2½-in. gauge quin, have flanges on the outside only, to allow more space between them for the eccentrics.

The hornstays are merely bits of strip mild-steel, cut and drilled as shown in the illustration, and attached to the hornblock feet (which should be filed flush with the bottom line of frame) by 3/32-in. or 7-B.A. screws. The holes in the axleboxes for the spring-pins, are located, drilled and tapped, as described above for gauge "1"; the springs are made and fitted in the same way. The spring plates are made in a similar way to the hornstays, and are secured by ordinary commercial nuts, as shown in the assembly drawing.



Coupled wheels (5-in., 2½-in. and "O" gauges)

Note on the Larger Sizes

The hornblocks and axleboxes for the 3½-in. gauge quin are machined and fitted in exactly the same way as those for the 2½-in. job, but to the sizes given, so no further detailing should be necessary. The hornblocks for the biggest girl of the family—"ee, ba goom, she's a gradely lass an' all," as they say in the neighbouring county—are also machined and fitted in similar fashion; but a hole is drilled down the middle of each central rib, to accommodate an oil pipe. Use ⅛ in. or No. 31 drill. This is shown in the detail sketch above the assembly.

The axleboxes are more like the full-sized article, being made in two pieces, with the lower section recessed out to take an oiling pad. The main part of each box is machined and fitted as described above for the smaller engines; but a section measuring $\frac{15}{16}$ in. wide, and the same depth, is milled out of the lower part, as shown. Cast axleboxes will probably have this gap formed in them. If a milling-machine isn't available to clean it out to size, or cut it from the solid when the box is made from bar material, the job can be done in the lathe, as usual, by holding the box horizontally in a machine-vice bolted to the vertical slide, and traversing it across an endmill, or preferably a home-made slot drill, held in the three-jaw. The operation is similar to that which I have described for milling the sides of the boxes.

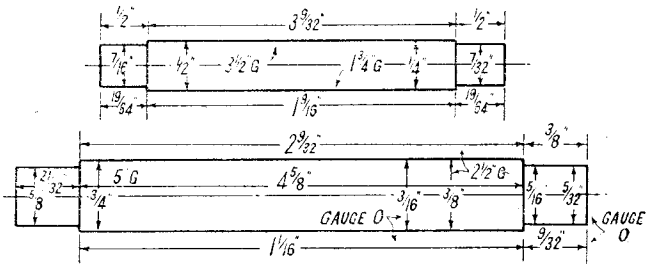
A block of the same kind of metal as used for the boxes, is then machined up to an exact fit in the gap. This is held temporarily in place with a toolmakers' cramp, and a No. 14 hole drilled edgewise through the lot, at ⅜ in. from the bottom, as shown in the drawing. Put a $\frac{3}{16}$-in. parallel reamer through, and fit a floating pin, made from $\frac{3}{16}$-in. silver-steel, with the ends slightly rounded, to retain the loose piece in place. The axleboxes may then be fitted to the hornblocks, marked off, drilled, and reamed, to suit the axles, in the same way as described for the smaller sizes, but to the given dimensions. Don't forget the oil holes. Mark the two sections of each box, to prevent their

getting mixed up; then take out each lower section, and endmill a recess in the curved part, just deep enough to touch the hole where the floating pin fits in. Hold the piece in a machine-vice bolted to the vertical-slide, feed it on to a small endmill or slot drill held in the three-jaw, and by careful manipulation of the cross and vertical-slide handles, the recess is easily formed. It doesn't matter a Continental about the corners being rounded. Unofficial history tells us that a certain party became so adept at operating the handles that when he wanted name-plates for his engine, he just clamped a strip of brass under the slide-rest tool-holder, put a 3/32-in. dental burr in the three-jaw, and milled out all the letters; but I'm open to bet that his baptismal moniker wasn't George Washington !

Anyway, if there is any difficulty in endmilling the recesses, they could easily be chipped out with a little chisel made from a couple of inches of $\frac{3}{16}$-in. silver-steel; a nice little exercise in hand craftsmanship, nearly a lost art nowadays. Inspector Meticulous can't see inside the boxes when the engine is erected; and as long as the recesses will hold the oiling pads, they don't have to be cut either to Michael's measurements, or with streamlined surfaces. The little pads should be made from close-grained felt; a bit of a discarded hat will do fine. Oil from the supply pipe will keep them well soaked, and the engine will run very freely, with no fear of hot boxes. The hornstays, spring pins, springs, spring-plates, and nuts, are all fitted as described for the smaller quins. May I just remind beginners that while axleboxes should never be tight in the horns—remember what happened at Weedon !—at the same time they shouldn't be sloppy; if they are, they will knock like the merry dickens when the engine, with a big load behind her tail, goes pounding over Ilkley Moor baht 'at.

Wheels and Axles

The whole family of quins have the same type of wheel, 14 spokes, hefty bosses, and big crescent-shaped balance-weights slightly off-set. Dimensions for the lot are given in the two reproduced drawings, and all are machined in the same way. Briefly, chuck in the three-jaw by the tread, setting to run as truly as the casting will allow; face the back (says Pat) centre, drill, ream, and take a truing-up cut off the flange. Reverse in chuck, face rim and boss; put the small rebate in at the junction of spokes and rim with a parting tool. Mount on an improvised faceplate, as described umpteen times already in previous notes, and rough-turn the treads to about 1/64 in. of finished size; then regrind the tool, and take the final cut off each tread without shifting the cross-slide. This ensures every wheel being exactly the same diameter, which is of the greatest importance in an eight-coupled engine. The flanges can be rounded off with a file.



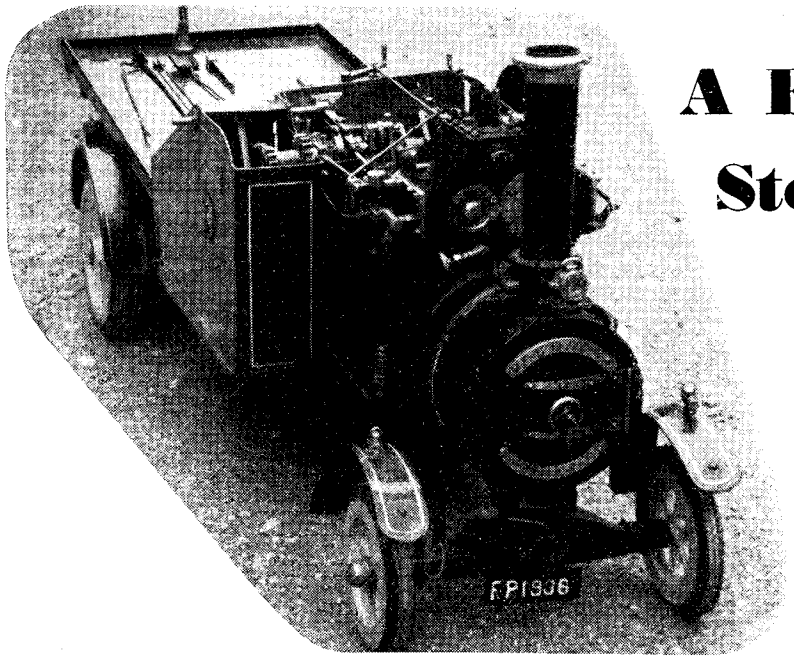
Axles—all gauges

Some folk advise having a chucking-boss cast on, gripping it in the three-jaw, and turning the whole wheel at one setting. I don't favour this at all, because first, unless the wheel is supported *at the rim* while the threads are being turned, there is bound to be chattering. Secondly, every wheel has to be separately measured; and even if the cross-slide is brought to a predetermined setting when taking the finishing cut, the wheels will probably come out different diameters, due to tool wear. If you take the tool out to grind it, then you've had it, as far as measurements are concerned. During my long years of actual locomotive-building experience, I've tried every method of wheel-turning, and recommend the one described above, which gives greatest accuracy.

The crankpin holes in the bosses are drilled by jig as usual. The jig is merely a short bit of rectangular bar, suited to the size of wheel. A peg is pressed into it near the end, the peg being turned to a nice push fit in the hole in the wheel boss, in which the axle fits. At the right distance from the crankpin hole, shown in the drawings, a hole is drilled in the jig, a shade under reaming size for the spigot of the crankpin. For the gauge "O" engine, no reaming will be needed for the crankpins, the holes in wheel bosses being drilled No. 43. To use the jig, put the peg in the axle hole in the wheel boss, set the jig bar centrally with the wheel boss, temporarily clamp in position, and drill right through the wheel boss, using the hole in the jig to guide the drill. This ensures all the crankpin holes being exactly the same distance from the centre of the axle. Finally ream each hole to the size shown on the drawing.

If your three-jaw chuck happens to be a paragon of virtue, the axles can be turned from ground mild-steel, or silver-steel, of the diameters given, the ends being turned to a press fit in the wheel bosses. Now beginners often ask for a simple way of ensuring press fits. Simple, my dear Watson, says Curlylock Holmes. Chuck any odd bit of rod, about the diameter of the axle, in the three-jaw, and carefully turn it to a tight push fit in the hole in the wheel boss; a simple rule-of thumb job. If your cross-slide screw has a " mike " collar, note the setting; we will assume that it is 53, that division being opposite the pointer. Well, when turning the wheel seats on the axles, finish-turn them with division 52 against the pointer, and Bob's your uncle. Before removing from the chuck, slightly ease the end of each wheel seat with a fine file, until it will just start in the wheel boss.

Should the chuck be a descendant of Ananias, it would be advisable to turn all the axles between centres, using steel of a little larger diameter. Cut the axles a little over length, face the ends in the chuck—it doesn't matter about it being "out" for that job—and centre with a small centre-drill. Turn the wheel seats first; then, with the carrier on the wheel seat at the mandrel end, the full length of the centre part of the axle, can be turned to correct diameter at one setting. One wheel can be pressed on each axle, using the bench vice as press if a proper one isn't available; but don't press on the second one, as we shall first have to fit the eccentrics for valve gear, pump, and mechanical lubricator. I hope to deal with the eccentrics, and other items, in the next spasm.



A Foden Steam Wagon

Built by
Col. W. L. A. Fedden
A.M.I. Mech.E.

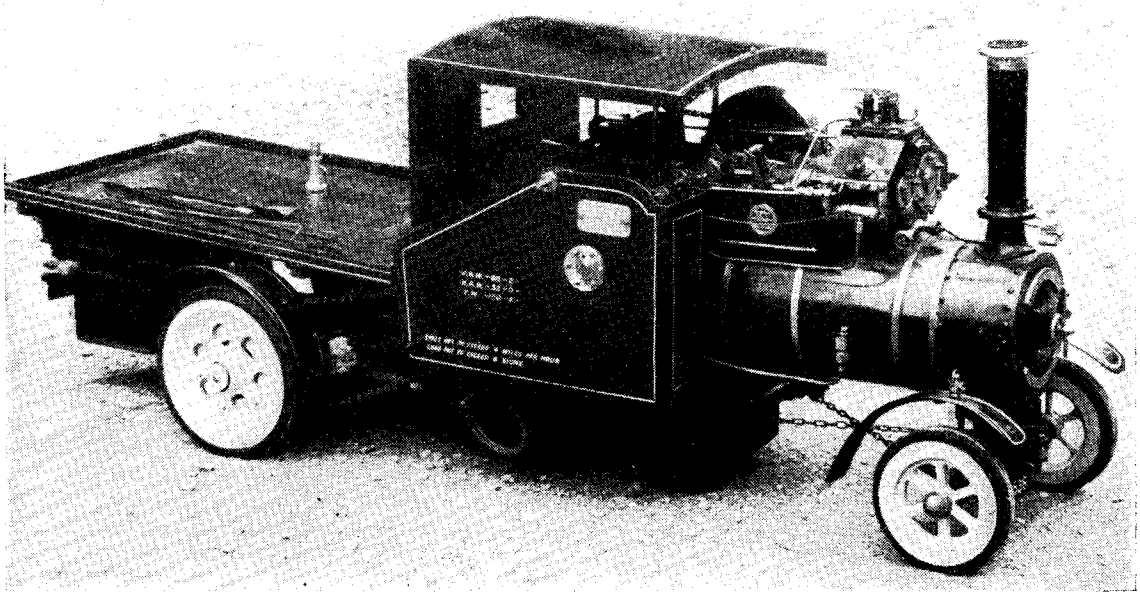
Described by
Andrew Smith

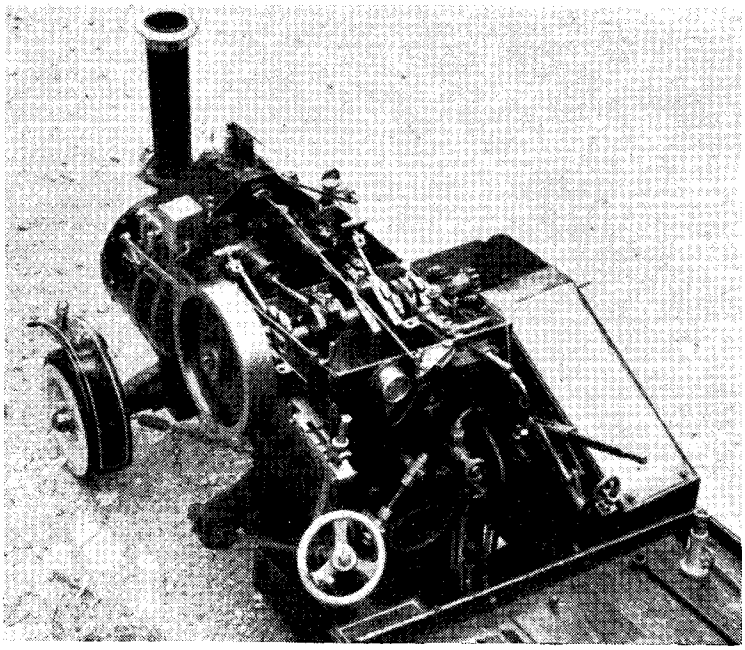
MOST models have in their genesis a little story. Perhaps the builder had a particular fancy for a certain locomotive or marine plant, or had, in the past, been connected with the prototype.

In the case of Col. Fedden, his desire to produce a Foden overtype steam wagon in miniature was born when he had the job of driving the original from Peshawar to Razmak on the North West Frontier of India, a distance of some 120 miles, being the only person present at the Peshawar workshops who had any experience of steam traction.

Construction of the model to scale of 2 in. to the foot was started in 1934 at Peshawar, where the Colonel, then Major Fedden, was Commanding Officer of a Mobile Repair Unit. Although material of a suitable nature, was in short supply, he was fortunate in having access to a foundry where all the necessary castings were made from his own patterns. Much of the work was done in the bedroom of his bungalow, which consisted of sleeping accommodation on one side of the room, and a model engineer's workshop on the other. Literally a case of "sleeping on the job"! In addition, he had access to a 6 in. and a 12 in. lathe, the latter having a 24 in. diameter faceplate, which he claims was just right for the cast-iron cylinder block, which was machined thereon!

The model is 3 ft. 9 in. long overall, 14 in. high and has a track of 10 in. It is compound with high and low pressure cylinders of 1 in.





"Bridge-view" of Col. W. L. A. Fedden's 2-in. scale Foden steam wagon, showing the controls

and 1⅞ in. bores respectively by 1½ in. stroke.

The crankshaft proved to be an interesting piece of machining, being turned from the solid, complete with eccentric sheaves. The material used was a short length of 2 in. diameter steel bar which had to be centred five times at each end. The crankshaft counterbalance weights are detachable. A two-shaft drive is employed with a final chain drive to the rear wheels. Stephenson link motion takes care of steam distribution, and a "L.B.S.C." type mechanical lubricator is fitted. Two speeds are available.

The present boiler is the second, the first being a rivet and soft solder job, which was not altogether satisfactory. The new one has a 5½ in. diameter barrel with a grate area of 30 sq. in.; 22 flue-tubes of ⅜ in. bore are fitted, plus two ¾ in. superheater flues, an improvement on the original boiler which was devoid of superheaters. The whole boiler is riveted and silver-soldered, working pressure is 80 lb. per sq. in. Total weight of the model is 110 lb.

The paintwork is carried out in A.S.C. (now R.A.S.C.) colours, bodywork blue, with yellow wheels and white lining. The brass plates on the smokebox door bear the inscription "Fedden, Peshawar," instead of "Foden Sandbank" as on the original, while the number-plate repeats this information together with the year of completion, 1936. Body and cab are correctly made in timber, sissoo (Dalbergia sissoo) a species of Indian rosewood and teak being the woods employed.

The lifting jack on the wagon is to scale and works, but Col. Fedden regrets that this is not so with the acetylene head-lamp or the oil sidelights !

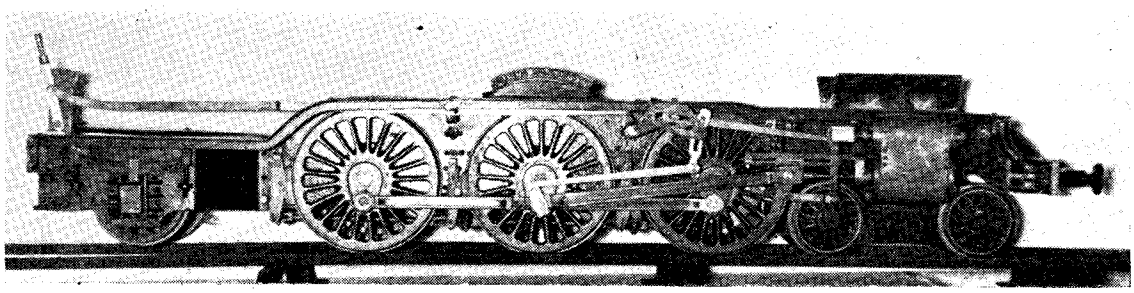
Both Col. Fedden and the writer are very much indebted to Mr. T. Webster of Bath for the great care he took in taking, processing and enlarging the photographs used to illustrate this description.

AN OCTOGENARIAN'S WORK

THIS photograph shows the present stage in construction of one of two 5-in. gauge locomotives being built by Mr. J. W. Laybourn, of Letchworth, who is a practical enthusiast 81 years young ! The two engines are both being built to the design of the late Sir Nigel Gresley's L.N.E.R. *Flying Scotsman* Pacific type, except that one has only two cylinders while the other has the proper full set of three.

The illustration shows the two-cylinder engine; the bore and stroke of the cylinders are, respectively, 1⅜ in. and 2 in. The driving and coupled wheels are 6½ in. diameter on tread. The bogie wheels were turned out of ⅞-in. plate, the spokes being drilled out and filed up. The crossheads were cut out of solid steel.

The only castings on these engines are the cylinders and chimneys, and with the exception of turning the driving wheels, the whole of the work is being done by Mr. Laybourn himself. The overall length of engine and tender is 6 ft. 2½ in. The three-cylinder engine is ready for assembly, and Mr. Laybourn hopes to have both of them finished during the next eight or nine months.



THE "ALLCHIN" TRACTION ENGINE

to 1½ in. Scale

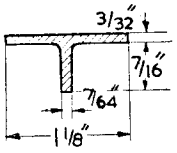
By W. J. Hughes

WHEN the blanks for the thirty-two hind-wheel spokes are all milled to shape, the next thing is to cut-off the waste. First of all take the "master," and cut the waste off the ends, nearly to the centre-dotted lines, using shears, chisel, or hacksaw.

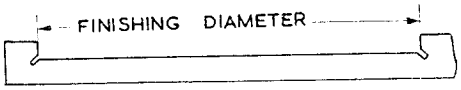
The curve of the outer edge of the palm should now be finished by filing; we have already centre-dotted the line, so be careful not to go beyond the marks. The inner end of the spoke only needs a rough trim with the file; some of them will probably require further trimming in any case, later on. On the palm of the spoke, the four corners require rounding slightly; about 1/32 in. radius will do.

Now the master can be used to set out the others; simply lay it on top of another blank, taking care to see that it is correctly placed, of course, and run the scriber round the top and bottom. Remove the master, and centre-dot the lines scribed on the other spoke. Then file the latter to shape, after cutting off the excess waste. Repeat for the remaining thirty spokes, using the same master as template each time to avoid cumulative errors.

Don't bother to drill any holes yet; they can be done later.



Section of hind wheel tee-rings



Gauge for diameter of tee-rings

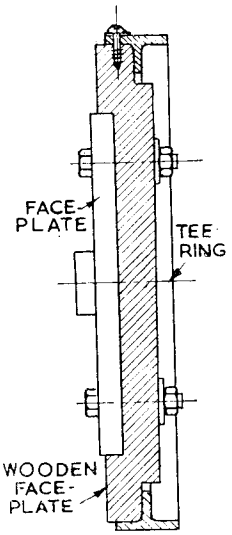
Hind-wheel Tee-rings

And now for the job which some Jeremiahs said was beyond the true capacity of a 3½-in. lathe; the hind-wheel tee-rings. As to the true capacity of *any* lathe, this depends to a large extent on the operator. The "press-on regardless" wallah will soon rack his machine up anyway, and then wonder why the mandrel wobbles and the slides chatter. However, if your lathe has been treated right, and is reasonably well-designed, then (in theory at least) its capacity ought only to be limited by its dimensions. At the same time, anyone who has access to a larger lathe might be well advised to use it for this job—no denying that! Still, before we start on machining methods, let us consider how the tee-rings can be made. As I said in an earlier article, these are two or three different ways of doing it.

From the Solid

One method, if you can obtain the material, is to turn them from the solid; either from thick-walled steel tubing, or from rings burnt out from 1¼ in. thick steel plate. I know of at least one constructor who is using the latter method. Another way is to have rings rolled and welded from flat material; then further rings are rolled *on edge* and welded or brazed inside the others to form the tee-rings. The materials used would have to be "full" on all dimensions to allow for turning, of course.

Still another method is that used by J. S. Christopher, of Ainsdale. He had four rings rolled and welded, for the "flat" rings, if we may use such a contradictory term. He then bolted a disc of sheet steel to the faceplate, and turned it to be a tight fit in one of the rings. At the same setting a ½-in. hole was bored centrally in the disc. Removing the latter from the lathe, it was "Easyflo'd" in the centre of the ring, and then remounted on the faceplate, using a ½ in. diameter stub in the lathe-mandrel to locate it truly. The outside and inside of the ring could then be machined to the correct dimensions, and finally parted off as a tee-ring. The method of getting the four "flat" rims all the same size was ingenious; Mr. Christopher bored a large hole in a thin disc of metal and allowed each ring to expand to be a tight fit in the hole. The welding was done by a friend. One of Mr. Christopher's wheels, partly erected, is shown in the photograph, together with bits and pieces of the other one.

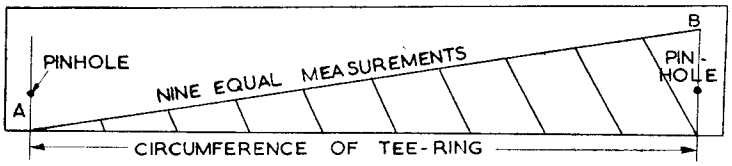


Method of mounting tee-ring for finish-turning

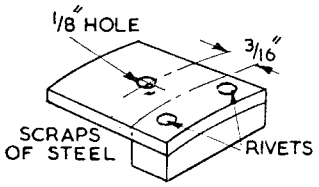
Malleable Castings

Having mentioned all these ways of doing the job, let us now turn to the one which I favour personally, and which I have used; to wit,

Continued from page 714, *Vol.* 109, *December* 17, 1953.



How to obtain spacing for $\frac{1}{8}$-in. holes



Jig for drilling fixing holes

castings of malleable iron, supplied, as usual, by Brer Reeves. I would not recommend cast-iron, which would not be safe in view of the thinness of the rim; but the malleable is admirable, especially when strengthened by the strakes being riveted on. All four tee-rings are identical, being $8\frac{7}{8}$ in. diameter by $1\frac{1}{8}$ in. wide; the cross-sectional dimensions are given herewith. A warning should be given about the diameter, though; as many readers will be aware, the shrinkage on malleable castings sometimes varies a little, and yours may be a tiny fraction over or under. This will not be serious, as it will be too small to be noticed, but do keep it in mind. Of course, a more generous machining allowance would make the difference up, but that would mean, in the long run, nearly twice as much metal to turn away; more wear and tear on the lathe, and more hours on the job !

First Operation

You will find that the casting has four lugs cast on to the inside web, which lugs are to enable one to clip the job to the faceplate. You will also find, in all probability, that the lugs are " bent," due to shrinkage in cooling, but a few blows with a heavy hammer on a steel block will set them straight again.

Lay the faceplate on the bench (face up, with a piece of *clean* paper or card under it to keep dirt off the boss), and lay the ring on it. If the ring rocks even slightly, due to one of the lugs still not being quite straight, alter this before proceeding further. Then use four clips or dogs to hold the work to the plate, as shown in the photograph, but don't tighten the nuts much. Screw the plate on to the mandrel-nose, and set the job to run as truly as possible. Tighten the nuts fully, and check for true-running again.

Use Oil

By the way, this operation will tighten the faceplate very much on the mandrel-nose, so before screwing it on, put several drops of oil on the thread of the latter, which makes removal much easier.

Use slowest backgear, and clean up the outer face and edge of the tee-ring. I used a round-nosed tool for this roughing—an ordinary high-speed one—and found, for my part, that the use or non-use of cutting-oil did not seem to affect either the finish, the efforts, or the tool. Following this, the tool was turned sideways and backwards, so to speak, as the photograph shows, and the inside part of the ring was roughed out.

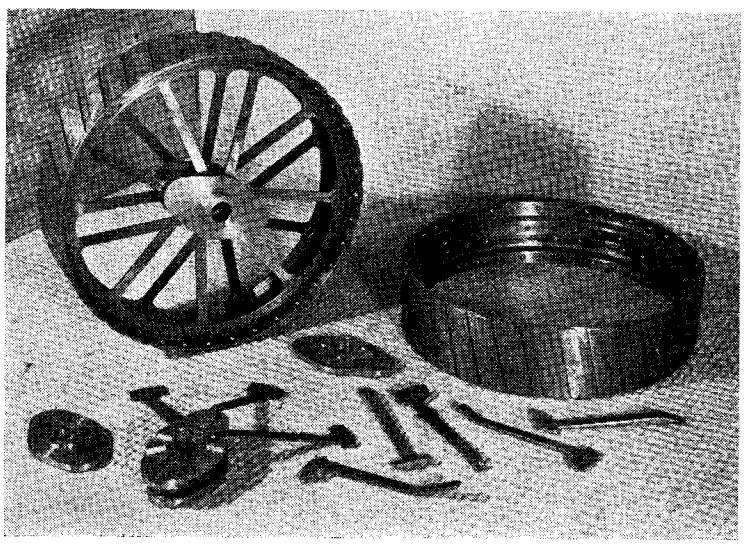
Diameter-gauge

Since your outside calipers will probably not span the finished diameter, it is advisable to make a gauge as sketched, from a suitable strip of, preferably, steel. This will help you in getting the four-rings all the same diameter, which is most important, naturally. Regrind the tool, and finish the outer diameter to the gauge, which should just slide over the rim. Then turn the tool to the same angle as before, so that it can be used to finish the inside of the rim, and the side of the web. Finally, finish-turn the outer edge of the rim.

You can now rough-turn the inside edge of the vertical web of the tee-ring, and at the same time part it off from the four lugs. This can be done by using the round-nosed tool, turned at right-angles. Don't force it straight in, so to speak, but work the cross-slide handle slightly to and fro in order to make the groove wider than the tool. Turn the other three tee-rings in the same way.

Finishing the Ring

The problem now is to hold the ring for turning the other side, because we can't clip this to the face-plate in the ordinary way. However, with the aid of a wooden auxiliary plate, the problem is soon solved, and fortunately, since the control has been removed from timber, there is no difficulty in getting what we require. Personally I already had a piece of well-seasoned pine about an inch thick which did the needful, and doubtless many of you will also be able to find something



Photograph No. 56. Hind wheels by J. S. Christopher in course of erection. (Photo. by J. S. Christopher)

suitable, in the workshop. You will need to cut out a circle of about 9 in. diameter, but it needn't be dead accurate. In fact, if you mark out the circle, and then keep sawing the corners off until you have a sixteen-sided figure, that will do.

We now have to turn a recess on one side, to be a good fit on the faceplate. If you have a second faceplate, fix the disc of wood to this, and turn the recess about $\frac{3}{8}$ in. to $\frac{1}{2}$ in. deep, nearly large enough in diameter to take the other plate. Then open out the recess carefully until it is a good fit for the plate. Failing a second faceplate, you can remove the backplate of a chuck, and use wood-screws to fasten the disc to it—but for goodness' sake take care not to damage the backplate at all !

When the recess is turned, remove the disc from the backplate or spare faceplate, and bolt the other faceplate in place in the recess Screw the plate on the mandrel-nose, and turn down the edge of the disc to be a good fit inside the turned side of the tee-ring. Also, take a skim over the outside part of the face, and round off the outside corner, to clear the radius on the tee-ring.

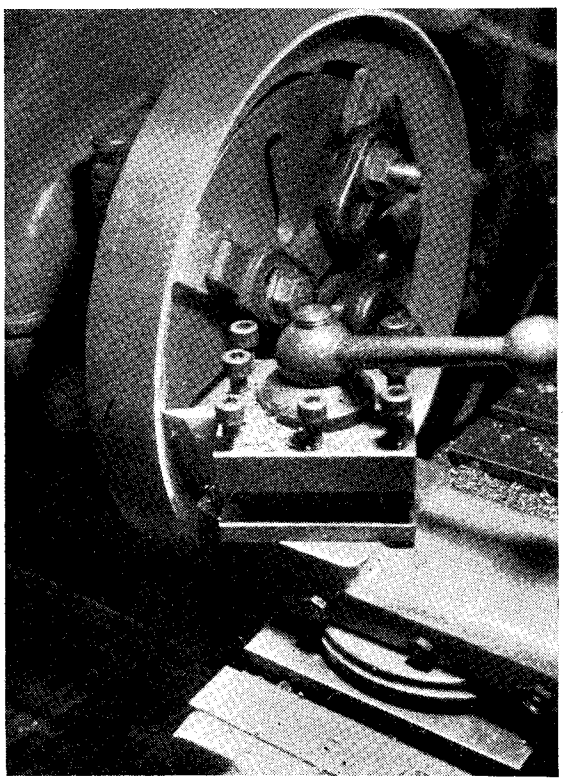
Securing the Ring

Now in the prototype, the strakes of the hind wheels are riveted to the tee-rings, but on alternate strakes, one of the rivets is omited, and the hole enlarged to allow the attachment of either spuds or frost-spikes. This is fortunate for us, because it gives us some $\frac{1}{8}$ in. diameter holes which we can use to secure the tee-ring to the wooden faceplate. Since the holes alternate (see photograph), there will be nine in each ring, equally spaced; that is, every fourth strake. These holes will be at a distance of $\frac{3}{16}$ in. from the edge of the rim, so set a pair of dividers or oddlegs to $\frac{3}{16}$ in., and scribe the line right round. Now this circumferential line has to be divided into nine equal parts; you can work this out mathematically, or set out with dividers in the usual way, or alternatively use the method I prefer (which I think is quicker and more accurate, anyway).

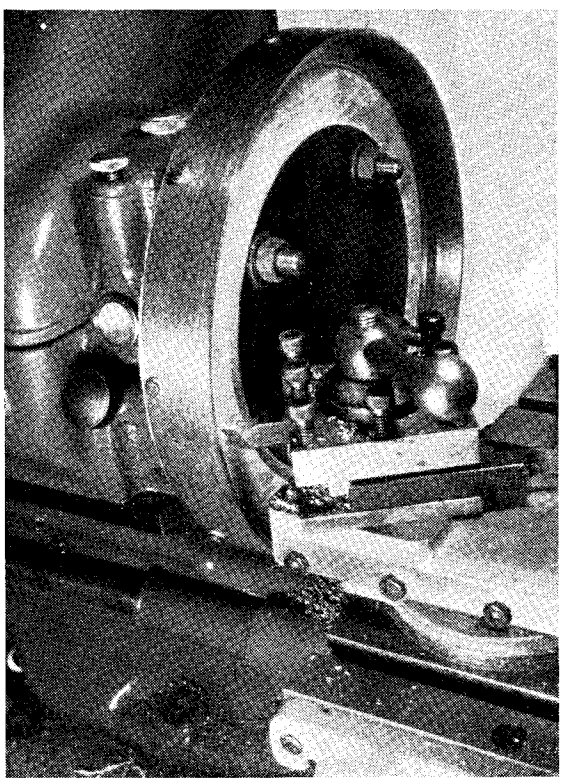
Take a strip of stoutish paper about 30 in. long by 6 in. wide, and wrap it tightly round the tee-ring, with the ends overlapping. Stick a pin through the overlapping ends, and remove the paper, which will now have a pin-hole near each end. Square a line through these; the distance between the lines will be equal to the exact circumference of the ring, of course (see sketch). Now divide this into nine in the old geometrical way, by drawing a line *AB* at an angle, and setting off on it nine equal divisions of, say, 3-in. Join the ends of the two lines, and through each division on *AB* draw lines parallel with the first, which will give nine equal divisions on the edge of the paper. Wrap the paper round the ring again, secure the ends with a bit of Sellotape, and transfer the divisions to the tee-ring.

The Drilling Jig

Set your bevel or protractor to 75 deg., or make a template to that angle, and scribe lines through the divisions across the ring. You can now make the little drilling-jig as sketched—which I think preferable—or centre-pop the intersections of the



Photograph No. 57. Final operation on first part of turning tee-ring, showing method of holding to face-plate



Photograph No. 58. Finishing operation on tee-ring, showing mounting on wooden auxiliary face-plate

Photograph No. 59. Hind wheel of "Royal Chester," to show strakes and holes for attaching spuds. (Photo. by J. S. Christopher)

lines and drill carefully to $\frac{1}{8}$ in. diameter. If the jig is used, the $\frac{3}{16}$ in. line can be omitted in the first place, of course; if clamped in position, the jig will automatically give this distance for each hole.

Finish-turning the Ring

Now press the ring on to the wooden faceplate, and see that the vertical web is flush up to the wood —if necessary, use cramps to force it up. Wood-screws may then be

Holes for woodscrews

inserted through the holes in the rim, into the edge of the wood. No. 4 or 5 screws are the size to use; preferably round-headed, with a suitable washer under the head, and $\frac{5}{8}$ in. or $\frac{3}{4}$ in. in length.

By the way, some chaps seem to forget that the shank of a wood-screw—the upper part—needs a clearance hole drilling, and a core hole should also be drilled for the threaded part, as in the sketch. Makes a lot of difference in inserting the screw, you know, especially in hardwood! When the ring is secured to the faceplate, the machining is simply a repeat of the operations on the other side, with the round-nosed tool. Finally, use a knife-tool, set sideways, to finish-turn the innermost edge of the vertical web. Remove the job from the wooden plate, and turn up the other three rings. They will then be ready for starting to build the wheels, but first we shall have to make the strakes.

Material for Strakes

There are 72 of these, and you will require just over 14 ft. of $\frac{7}{16}$ in. $\times$ 16-g. mild-steel strip to make them —say 15 ft. to be on the safe side. This size of strip $\frac{7}{16}$ in. by $\frac{1}{16}$ in.— does not appear to be a commercial size, but friend Reeves can supply it, sheared from sheet. Actually, this is not a bad thing, because the shearing action gives the strip a slight curve in the cross-section, which will save us some trouble when we eventually come to fit the strakes to the rims.

Tail-piece

And that, for this time, will be where I must leave off, but not before I have thanked the many kind friends who sent me their expressions of goodwill at Xmas. As I write, I can glance round and see them; the large majority are from this country, but there are plenty of others from many different parts of the world. It is very heart-warming to know that so many people wish one well, and it would be nice to acknowledge them all individually. But since that is impossible, perhaps this note of sincere thanks to one and all will be accepted in lieu of separate notes. Many thanks indeed, and all good wishes for 1954; in fact, the last go to *all* my readers. May all your snags be little ones!

Meantime, my apologies to Ian Sinclair (Foden 1143) of Australia, and R. Palmer of Southampton, to both of whom I intended to send my own greetings card, but whose addresses I have lost. Perhaps they will write again at their leisure?

(To be continued)

TOOLING OUT SMALL BORES

By "Scotia"

IT is a well-known fact that a lathe tool, be it drill, cutter or turning tool, when in contact with the work in the normal way, is subject to stress. The first indication of this is given in the form of vibration, and it is useful to remember that some use may be made of this fact, should the occasion arise.

Suppose, for example, it is required to "pick up" a step or smaller diameter in a fairly deep hole of small size, when it is not possible to observe just where the point of the tool will make contact.

It is natural for the worker to proceed with caution till the tool is cutting in the desired manner, and it may be possible to know when contact is made by listening keenly for the tiny sound which invariably arises through contact with the work.

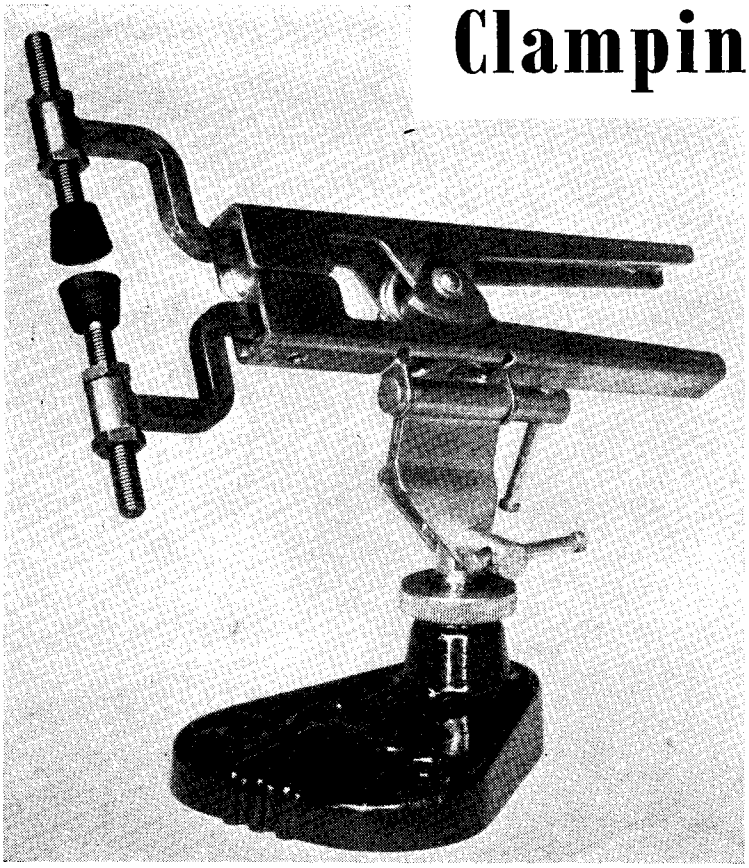
Perhaps an easier way, however, is to touch lightly the shank of the tool with the index finger while contact is being sought, an indication being given when this occurs, by the vibration set up.

Although it is useful to have thin finely-ground tools for boring-out small holes, care must be taken to see that they are, in themselves, rigid enough to tool out an out-of-truth hole, and a slight increase of speed and reduction of feed will quite often suffice to bring this about.

It is often possible, too, provided that a fine feed is in use, to damp out vibration or oscillation to some extent by gripping the shank of the tool firmly with the finger-tips. In this connection, it is sometimes an advantage to use a fold or two of thin cardboard (a cigarette-packet will do) as packing under the tool, as this appears to have a cushioning effect, when the tool is cutting, and is clearly an advantage when tooling-out small deep holes such as those referred to.

Finally, it is useful to remember that in tooling-out a "through" hole, a finger on the shank of the tool will give an indication at once when the tool has gone through, by the cessation of vibration, and a check on the depth can be made, should this be necessary.

Clamping Devices



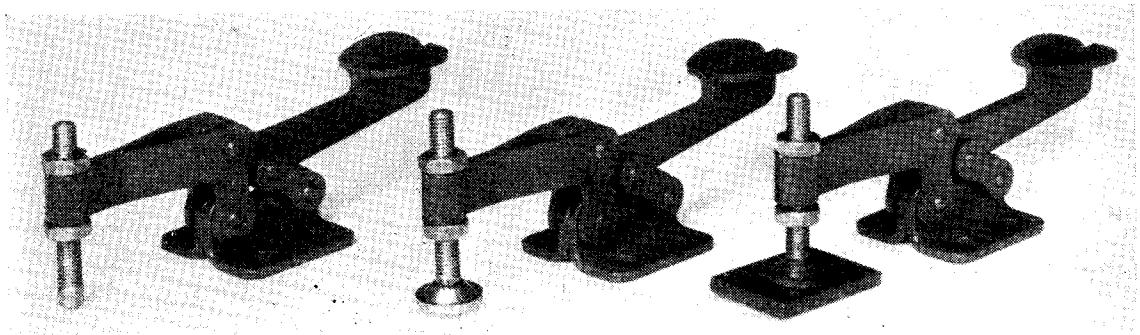
" An extra pair of hands "

AMONG the many aids to engineering production in modern times, the development and increasing use of various forms of quick-acting clamping devices take a very important place. They are now applied in many forms of jigs for machining and assembly, to facilitate and expedite handling, but their use is by no means confined to mass-production, and many forms of these clamps can be employed to good advantage in the small workshop, for purposes such as holding work down on the bench or marking-off table, or parts in true relative location for drilling, filing, cementing or soldering. While these devices do not take the place of screw clamps, they offer many advantages where speed of application is desirable or necessary.

Messrs. F. Brauer Ltd., of Grove Road, Harpenden, Herts, have submitted to us samples of their well-known quick-acting toggle clamps, which are made in a wide variety of sizes and types, and are extensively used in many industries. Clamps operating on this principle became very popular during the war, mainly for use in aircraft assembly, where speed of operation was of the highest importance, but the demand for them has still further increased in peace-time industries, enabling them to be made in larger quantities, with improvements in accuracy and design. We have been very favourably impressed, both with the quality of these appliances, and their utility.

Spring-Loaded Tongs

A new appliance recently developed by Messrs. Brauer incorporates a pair of powerfully spring-loaded tongs with interchangeable jaws, mounted so as to be capable of swivelling in any plane, on a stand which can be screwed or clamped to the bench. It can thus be adjusted and locked at any angle, and jaws may be fitted to hold work of any shape. Provision can be made for operating the tongs pneumatically, or by a foot pedal, through a Bowden cable, and in this form it can be arranged so as to leave both of the operator's hands entirely free. It thus deserves the title " an Extra Pair of Hands " which the makers have applied to it, and we can think of many workshop jobs where such a device is wellnigh a necessity.



Examples of quick-action Toggle clamps

READERS' LETTERS

● **Letters of general interest on all subjects relating to model engineering are welcomed. A nom-de-plume may be used if desired, but the name and address of the sender must accomapny the letter. The Managing Editor does not accept responsibility for the views expressed by correspondents.**

VALVE DIAGRAMS

DEAR SIR,—It appears I have incurred the " maestro's " displeasure with my article on " Laying Out Stephenson's Valve-gear "; but at the risk of even more displeasure I feel I must give my side of the picture.

I quite agree that a valve-gear is simply the means for operating a slide, or piston-valve in such a manner that it opens and closes ports in a cylinder to the right amount at the right time; but the snag is the " when and how " part, despite common-sense or otherwise, and having spent a few years as an engineer at sea, I possess at least my fair share of that valuable sense.

Again, I would be very surprised if, after half a century of trial and error, experiment and what have you, " L.B.S.C." cannot lay out a valve-gear by hanging the bits and pieces in the handiest spots and, of course, they will work, especially with his gift of being able to visualise the finished job.

I, too, possess an invaluable asset which is: to see the finished job down on paper as a working drawing, and even though I can produce drawings which are fit for publication it is a job I hate second only to using figures.

Now figures as such are undoubtedly unnecessary, but a few simple formulae used intelligently and with common-sense can help quite a lot in the design and testing stages, especially if one understands something of the square-cube laws and where to apply them in departing from " full-size " laws.

Our friend doesn't need them because of his half-century of experience, neither does anyone else who thinks he is " designing " when all he is doing is to look up " L.B.S.C.'s " articles to see what he did in a similar layout. At the same time, he may be surprised to know how much I agree with him and how so much he recommends can be proved by the despised figures.

As for the " link-slip " diagram, what is that but a drawing board-model method? And as I drew both the rough and finished tracing in an *evening*, besides finding out my detail proportions, I fail to see how it is a longer method than making a model, especially as cutting out circles for eccentrics and eccentric rods, etc., is avoided.

With regard to diagrams, it is surprising that although writers on land and marine engines can use them *ad lib* without comment, if anyone dares to mention them with regard to locomotives the sparks fly.

As far as I am aware, I did not suggest that valve diagrams are necessary. What I *did* suggest was their use in finding the remaining data, if design, or experience has shown that some particular feature, or event must be used; and it was gone into fairly thoroughly and as simply as possible for the benefit of, not only those interested in locomotives, but also marine and land engines and may not clearly understand them.

Neither can anyone doubt the use of diagrams to find out the valve setting of an engine from a drawing, and I can assure anyone it is quicker than making a model of the arrangement if it should be a Stephenson's gear, the only gear I mentioned in my article. Again all the diagrams were roughed out in an *evening* and traced the next *evening*, a bit different from the weeks mentioned; and I also notice that no one has yet challenged any of the valve events I gave, either of original engines or on my own model. Neither has there been any disagreement on the other points I mentioned in the article.

Since writing the article, I have had placed at my disposal Clarke's *Locomotive Engineering*, published before Colburn, the author of which collaborated with Colburn in his book. The valve design part of this book has never been excelled, and I for one would like to see that part republished; but one thing is certain: "Roly Poly" diagrams had not been evolved by the time these books were published.

Finally, although I don't always agree with " L.B.S.C.," I will say that I doubt if any of his 100 per cent. adherents have a higher regard for him than myself, or always appreciate just what he has done.

Yours faithfully,
Maidenhead. D. G. WEBSTER.

ATOMIC AFTERMATH!

DEAR SIR,—It is a pity that bloke Oxley's workshop was left in smoking ruins and possibly he with it, because one would like some more information from this genius.

I am probably a bit dense, but I am not quite able to follow *all* of his instructions. One would like to know how to use that very clever D-tool he has designed. Presumably to cut l.h. and r.h. threads simultaneously, one point is put in front of the work and the other at the back, or *vice versa*, but the drawing does not show them in the right position for this.

How is Fig. 2 set up for machining? The thread is not concentric with the only part recognisable as a nut. And what are the spots for? My first impression of this, before reading the text, was that it was a poodle emerging from a drainpipe.

Finally, I would remind him (or his wraith) that 3/9 is usually written 1/3 (the aliquot part I mean, not three-and-ninepence = one-and-three pence lest I be pulled up for this), and that he has left the π out of his application of the formula, so vitiating his conclusion*.

Incidentally, " Teardrop " in the issue of November 26th, 1953, assumes too much about the lack of strength of Mr. Thump. That such feats are possible is shown by the legend of St. Benezet and the Pont d'Avignon. The Rhone is rather wider than Cricklewood Broadway.

Yours faithfully,
Snaresbrook. C. H. CLARKE.

* [Read again, Mr. Clarke—Mr. Oxley did not forget to include the " pie."—ED, " M.E."]

THAT CHRISTMAS NUMBER

DEAR SIR,—I wish to put on record a strong protest concerning the article by Mr. Michael Oxley in the Christmas Number which is definitely misleading. For example, every time I place a cup of tea in the gap of the lathe, the carrier-thing comes round and knocks it on the floor. My family now drink out of jam-jars!

Next, about the thrupple nut. By pure coincidence, a neighbour had damaged the thrupple-nut on

his lawnmower, though to reveal in what way might well lead to international tension and the intervention of M.I.5. However, good old Joseph Soap next door—to wit, myself—was asked to make a new one; but when I wrote to the Admiralty for a piece of their bronze they turned me down flat!

I could go on picking out discrepancies in Mr. Oxley's article—for instance, there is a glaring error in his screw-cutting formula.

Finally, a query to Mr. Terry Aspin. In his centre-spread drawing, the character with the beret and whiskers has an accessory on his right known technically, I believe, as a "popsie." How does this accessory work, and can they be obtained at any good hardware store?

Yours faithfully,
Sheffield. W. J. Hughes.

DEFINING THE ENGINEER

DEAR SIR,—Perhaps the following may be of interest to you, in view of the many times you must be asked that very embarrassing question: "What is an engineer?"

In 1915, I was given some aircraft parts to modify and this called for holes tapped $\frac{1}{8}$ in. gas to a tolerance of 2-thou.

I was in Central London then, and went to Messrs. G. Adams of Holborn and purchased a couple of taps. On producing a few trial parts, they were found to be several thou. small, so went back to Messrs. Adams and complained. The late Mr. G. Adams attended to my complaint and gave me some very fatherly advice and said: "Young man, are you aware of the type of 'engineer' that uses these taps? His equipment is a rush basket containing several villainous pipe grips and tongs, a hammer and some blunt chisels, a pot of red lead and some tow, and other junk. He does not require taps to the accuracy you require." The old gentleman went through his stock and soon produced some taps which were perfect. A friend of mine has now sent me a description of the engineer in 1953.

"An engineer is a person who passes as an exacting expert on the basis of being able to turn out with prolific fortitude infinite strings of incomprehensible formulae calculated with micromatic precision from vague assumptions which are based on debatable figures taken from inconclusive experiments carried out with instruments of problematical accuracy by persons of doubtful reliability and questionable mentality for the avowed purpose of annoying and confounding hopeless chimerical groups of fanatics referred to all too frequently as 'engineers'."

So now we know? After 38 years, we do not seem to have improved much.

Yours faithfully,
Winscombe. J. W. TRACEY.

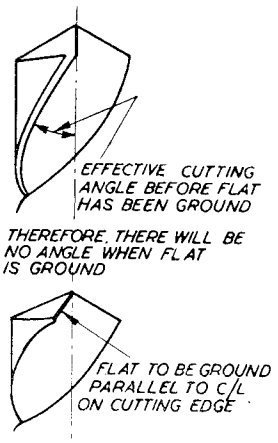
MACHINING PHOSPHOR BRONZE

DEAR SIR,—In the Christmas issue of THE MODEL ENGINEER (December 10th, 1953), I was reading a query by H.P. on the machining of phosphor bronze.

I too, have found some difficulty in machining "hard stuff." However, this can be overcome in a drilling operation, using an ordinary twist drill as follows:—

On the cutting edges of the drill, a flat is ground parallel with the centreline of the drill. This then becomes practically the same as a straight flute drill.

Care must be taken whilst grinding the flat, to take off only a few


EFFECTIVE CUTTING ANGLE BEFORE FLAT HAS BEEN GROUND
THEREFORE, THERE WILL BE NO ANGLE WHEN FLAT IS GROUND
FLAT TO BE GROUND PARALLEL TO C/L ON CUTTING EDGE

thou. or the drill will be spoiled for drilling steel, etc. It only needs a mere touch on the end of the grinding wheel, or a few rubs with an oil stone.

This prevents the drill digging in, and turning round in the tailstock Morse taper.

In a turning operation, I usually keep my tools keen, as suggested by the editor, by honing on all ground sides, and a negative top rake of approx 2 deg. or 3 deg. will sometimes be found an advantage.

A continuous stream of coolant should be kept running on the work if possible, although I don't find it absolutely necessary.

Yours faithfully,
Bolton. B. BETLEY.

STEAM ENGINE DESIGN

DEAR SIR,—The article on the oscillating steam engine by C. Horace Clarke in THE MODEL ENGINEER, Nov. 26th is undoubtedly a very well thought-out and clever design. But one thing seems rather weak to my mind. That is the shortness of the stroke. I had always thought that this particular type of engine worked best with a very long stroke.

In the past I have made quite a few different kinds of oscillating engines, V and radial (one had seven cylinders). I don't think the double acting effect is so very necessary. True, it is better in some cases (valves) but a two-cylinder oscillating has very little less power than a single-cylinder valve, and look how simple it is compared with the valve engine.

The sliding faces don't need a spring to hold them in place. In fact, that is a great weakness, as it permits loss of steam. I have often wondered why someone has not designed a kind of a "two-stroke" steam engine. By this I mean an engine that would be as simple as is the two-stroke i.c. in comparison with the four-stroke.

Surely the piston could be made to open and close ports. I can't think of a way myself, but I have no doubt some one might. What about a rotary? I remember years ago seeing a compressed air rotary engine made by a gentleman in Hertford (I think). He used to fly aeroplanes (model) with it. This was a very delicate engine but one could be made much stronger.

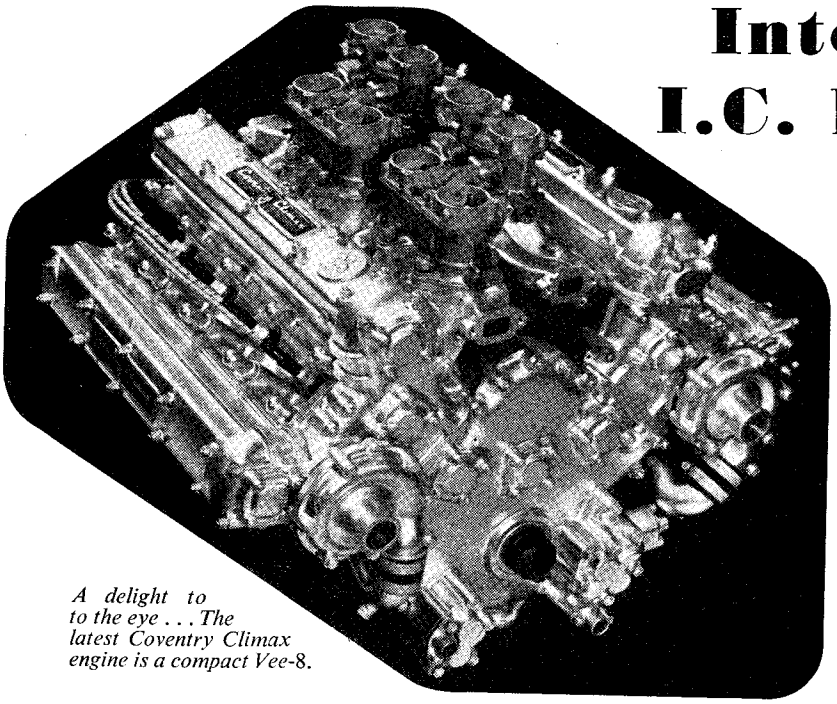
I have been surprised to know that no one seems to have made a steam cycle motor, one to fit on a cycle. The power of these little units is very small. Surely some steam enthusiast might have a go. The tiny railway engines one sees pulling several passengers should be able to take one, and the size would compare with a modern cycle motor.

Yours faithfully,
London, W. C. V. THOMPSON.

[Several types of "valveless" steam engines have been devised, some of which have been described in THE MODEL ENGINEER in the past; a typical example is the Willans three-cylinder engine in which the pistons act as valves to control steam to adjacent cylinders. Several types of rotary engines have also been devised, but there is no intrinsic merit in the rotary principle itself. Steam motor-cycles have also been described, but little interest has been shown in this subject in recent years.—ED., "M.E."].

Interesting I.C. ENGINES

An Industrial Unit with High-speed Possibilities



A delight to to the eye . . . The latest Coventry Climax engine is a compact Vee-8.

THE vee-eight 2½-litre Coventry Climax Godiva engine appears to combine all the best features of modern high-performance internal-combustion power units in a highly practical and uncomplicated form. Engineers have been quick to appreciate the considerable virtues of what was intended as a general-purpose and industrial unit, and it is a measure of their confidence both in the design of the engine and the reputation of the manufacturer that at least one well-known racing car concern has made plans to use the new engine in the 1954 Grand Prix racing season.

The engine was designed primarily as an industrial unit, in which field there is a pressing demand for the lightening of structures for various reasons, and where, at the same time, increased power outputs are required. Since the designers, W. T. F. Hassan and H. Mundy, however, have both been at some time intimately concerned with the development of high-performance cars, it can be scarcely a coincidence that this unit almost begs to be tuned for maximum output, or that it " happens " to be of the cubic capacity demanded by the new Grand Prix formula for unsupercharged engines.

The outstanding features of the new engine—which is quite justifiably described as " exciting " by the racing fraternity—are the use of R.R. 50 aluminium alloy for block and heads, the operation of the valves by twin overhead camshafts and piston-type tappets, and the direct-contact cooling of the exhaust-valve guides.

Equally interesting from an academic point of view is the optional provision of an epicyclic reduction gear unit between crankshaft and clutch. This gives a primary reduction of 1.41 to 1 and makes it possible to use this unit, if necessary, with existing final-drive assemblies. This might not otherwise be practicable, for the Coventry Climax engine peaks at 8,500 r.p.m.

This unit is beautiful to look upon, and if its rightness of appearance is a reliable indication it should have notable successes. The accompanying photograph tells its own story and the twin-cam heads, water-impellers and four twin-choke carburettors are prominent. Later, it is intended to use a fuel-injection system.

The makers have adopted an " over-square " bore-stroke ratio. That is to say, the bore, at 76.2 mm. is considerably greater than the stroke, at 67.94 mm. This is in interesting contrast to the racing engines of pre-war days, which were usually of the long-stroke type, but there is a marked tendency, these days, to keep piston speeds down.

The EN 23 forged-steel crankshaft is carried in five 2½-in. main bearings with lead-bronze shells. A very interesting point is that the alloy main-bearing caps are retained not only by the conventional studs, but by horizontal transverse set-bolts. This enhances the rigidity of a unit which is already remarkable for that quality. The con-rods are forged from EN 24 steel and the crankpins run in lead-bronze big-end shells. The distance between big-end and little-end centres is only 5 in. Big-end caps are tongued-and-grooved into the rods at 45 deg., so that the rods can be lifted up through the bores. Wet cylinder liners of cast-iron are used, with a rubber sealing ring at the base and a simple flange at the top. Valves are inclined at 32 deg. and 34 deg. respectively for inlets and exhausts. The former are slightly larger than the latter, which are sodium-filled. Valve guides are of phosphor-bronze, those of the exhaust valves being cooled by direct contact with the cooling-water in the head. Austenitic-iron valve-seat inserts are shrunk into the heads. The inlet ports are swept at an angle, in the interests of turbulence, towards the sparking-plugs. The plugs themselves are inclined at 25 deg. from the cylinder axis.

It has already been mentioned that the valves are operated by overhead camshafts working direct on to piston-type tappets. These " pistons " are inverted and are made in nitrided steel. Adjustment is provided by the use of small thimbles which can be ground to the correct clearance, this being, of course, fairly conventional, as is the use of hairpin-type valve springs, which have been used on a number of racing machines. The overhead camshafts are driven by separate trains of case-hardened and ground-steel gears.

(*Continued on next page*)

QUERIES AND REPLIES

"THE M.E." FREE ADVICE SERVICE. Queries from readers on matters connected with model engineering are replied to by post as promptly as possible. If considered of general interest the query and reply may also be published on this page. The following rules must, however, be complied with:

(1) Queries must be of a practical nature on subjects within the scope of this journal.
(2) Only queries which admit of a reasonably brief reply can be dealt with.
(3) Queries should not be sent under the same cover as any other communication.
(4) Queries involving the buying, selling, or valuation of models or equipment, or hypothetical queries such as examination questions, cannot be answered.
(5) A stamped addressed envelope must accompany each query.
(6) Envelopes must be marked "Query" and be addressed to THE MODEL ENGINEER, 19-20, Noel Street, London, W.1.

Flat Lapping

I am having trouble in lapping a flat-disc rotary-valve for a model petrol engine which I am constructing, using a cast-iron lapping plate and fine valve grinding paste. The trouble is that I seem to lap more off one edge of the disc, and feel that this may be due to uneven lapping pressure, or to the fact that more lapping paste builds up on one side of the lap. What can I do to avoid this.

R.O.S. (Louth).

Your trouble is probably caused by your lapping in a circular or back-and-forth motion, which tends to exert more pressure on one side of the job than on the other. Flat lapping should always be done with a *figure-eight* motion, which distributes the pressure more evenly.

The surface of the lap should have a series of deep diagonal grooves, forming a diamond pattern, as these grooves hold the lapping paste, and tend to a more even distribution.

Reconditioning Files

Over several years I have accumulated a large collection of old files which I am, somehow, reluctant to throw away. I believe that it is possible to recondition these by some acid process, but I cannot find any particulars of this. Can you give me any information?

C.S. (Perth).

There is, as you say, an acid method of renovating old files, although we have had no personal experience of this, and cannot vouch for the results.

The file must be thoroughly degreased by immersion in a caustic soda solution, having first picked out all metal particles, which have become pinned, with a scriber. It must then be thoroughly washed to remove all traces of the solution.

The file is then dipped in a solution of 1 part nitric acid, 3 parts sulphuric acid, and 7 parts of water. Immersion time varies from 5 sec. to 5 min., according to the condition and fineness of the teeth, after which it is again thoroughly washed in water. Our recipe, which is an old one, recommends that the file be then dipped in milk of lime, brushed over with olive oil and turpentine, and finally dusted with powdered coke, but these refinements could undoubtedly be omitted. Should you try out this experiment we would be interested to know the results.

Plastic Knobs

I wish to make some black plastic or ebonite knobs to fit to the levers of my lathe. Can you advise me what material to use, and where it may be obtained? Can suitable knobs be bought ready made?

P.H. (Norwich).

Material suitable for making black knobs for machine tools can be bought from Messrs. H. Robinson, Dominion House, Bartholomew Close, London, E.C.1. As ebonite would be rather expensive, we suggest that you use the black "Catalin" rod, which machines and polishes extremely well. Other plastic materials, including bakelite and vulcanised fibre, can also be used.

We have obtained suitable knobs from our local garage, where they are supplied in various sizes as replacements for car gear-levers, and doubtless your local garage could obtain these for you.

Filtering Paraffin Oil

I have a fair quantity of paraffin oil which I have used for cleaning parts of my car, and which has become very dirty. Although I am quite willing to discard it, the problem is what to do with it, as I understand it is illegal to pour it down the drains, and tipping it on the garden would be "smelly" and bad for the soil. It occurred to me that it might be possible to filter this oil for further use. Do you know of any simple method of doing this?

L.A.M. (Birkenhead).

A cheap and efficient filter suitable for your purpose may be made as follows. Take a large common flower-pot, and plug the hole with a piece of sponge. Put in a layer of powdered charcoal, about an inch thick, and another similar layer of silver sand. On top of this, put a layer of small stones and coarse gravel to a thickness of another two inches.

The powdered charcoal may be obtained from most aquarium dealers, as it is used in aquarium filters, and the silver sand may be had from any oilshop.

INTERESTING I.C. ENGINES

(*Continued from previous page*)

Dry-sump lubrication is employed, as in many high-performance engines, there being pressure and scavenge oil pumps driven from the crankshaft half-speed gear through an idler. Maximum total oil flow is 600 gallons per hour.

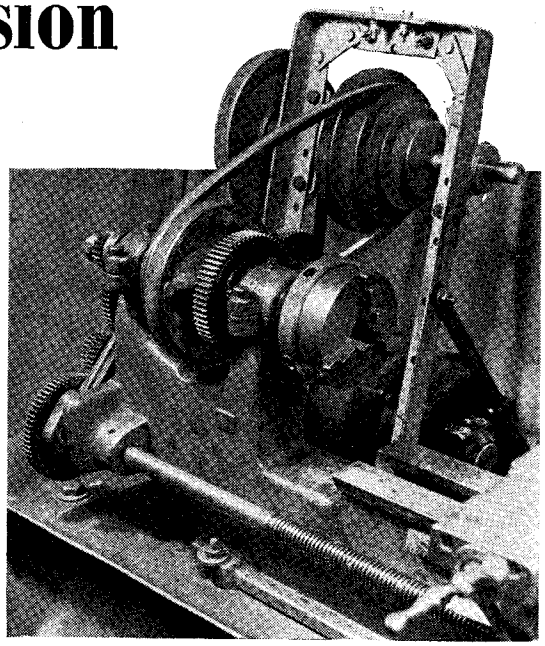
A single Lucas magneto is the source of ignition and is driven by a tubular shaft from the central idler gear. This shaft permits a minute degree of torsion, thus damping vibration.

It is obvious that considerable thought has been given to the attainment of good balance and absence of undesirable couples in this engine, and of course, these factors are highly important in any engine running at such high speeds.

Balance webs are bolted on to the extended crankshaft webs and they are recessed into those webs so that centrifugal loading is taken off the bolts. The crankshaft has been fully investigated for torsional vibration periods, but provision has been made for the fitting of a damper on the front end if necessary. The cylinders on the right bank fire first, in the order, 1, 3, 4, 2 and then the left bank fires 2, 1, 3, 4.

Power output of this engine, in racing trim, is stated to be 250 b.h.p. at 8,500 r.p.m. and piston speed at those revs. is 3,800 ft. per min. which, as might be expected, is not by any means excessive, by reason of the short stroke.

Vee Belt conversion of an M.L.2

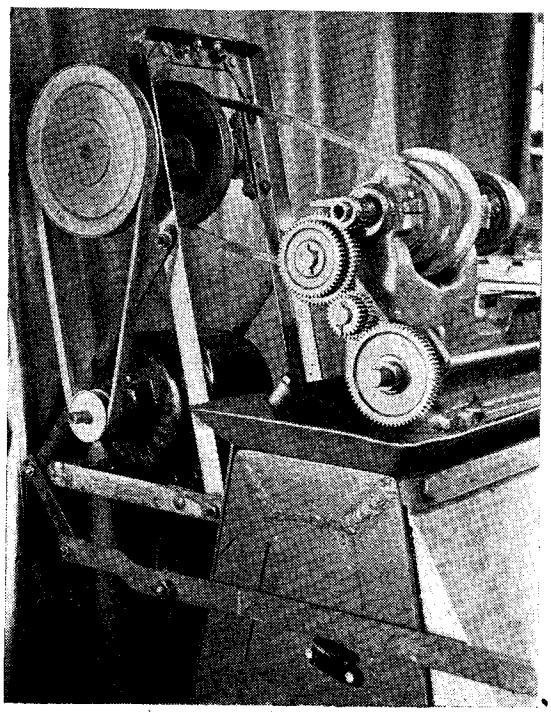


by W. D. Arnot

SO well known is the M.L.7 lathe that the models from which it stems are little recognised by their type designation. The M.L.2 comes up frequently in your advertising columns and new entrants to the model engineering fraternity must wonder what an M.L.2 is, especially as the M.L. series covers wood-turning lathes as well as metal.

I have worked an M.L.2 lathe, which is of 3½ in. centres for metal cutting, for many years, and have always been conscious of the inconvenience, as regards belt tensioning, in the use of flat belt drive cones. Consequently, I modified the lathe for vee belt drive recently, as illustrated in the two photographs.

Unaware that a vee belt headstock pulley was at one time offered by the makers—if not for this lathe, then for its immediate successor, the same lathe, but with attached headstock and not cast integral with the bed as in my model — I found that by taking a Picador four-step vee pulley of 5½ in., 4½ in., 3½ in., 2½ in., outside diameters and slicing off the largest sheave, I had width room to spare, filled by a spacing collar, and bottom clearance; but only just. A snag that, not anticipated, but as there is metal enough in the headstock, this was grooved by a half-round file deep enough to allow the belt to be changed from and to the 4½ in. sheave.



The swinging tensioning and motor frame, hinged to the lathe stand by a builders' door hinge, is built up from the ironwork of a war surplus hospital bed frame and straps from old prams. Up to that point the costs are very small, but the new pulley work costs quite a bit. Two cone pulleys, 12s. each; two ⅝ in. countershaft bearings 3s. 6d. each; one 6 in. pulley, 6s.; one 2 in. motor pulley, 2s. 6d.; two 10 in. "A" (½ in.) belts, 5s. each. All the same, the result is cheap compared with the price of a purchased ready-made unit.

The resulting silence of drive is remarkable and pleasing; there is no belt joint slap and I can hear what the tool is doing, which is quite an asset.

A few operations involved in this job may be of interest. The fourth sheave of one cone pulley was parted by working a parting tool in from the outside at the belt taper angle, to about half depth of the estimated metal section. Then a vee point boring tool was sunk into the rim from the inside to meet the parting tool recess.

One fault of the lathe had been that the drive cone and the back-gear drive mandrel gear wheel are secured by a grub-screw, which tends to swell the countersinks they enter and thereby lock the units against free rotation when released.

Getting the ball thrust-bearing in and out is a nice problem in this lathe. Against the mandrel thrust collar, behind the mandrel nose thread, is a cupped hardened washer recessed to carry 30 balls ⅛ in. diameter which bear against another hardened flat washer in the housing recess. There is no ball cage, and on withdrawing the mandrel the balls are apt to get lost. The correct procedure was found to be to place a box below the race when withdrawing the mandrel, since the backwasher does not come away with the front one due to adhesion in its seating caused by lubricant.

The balls all fall safely into the box. To get them back in the assembled state, the mandrel is stood on end in some recess, the cup washer threaded over the mandrel, to rest on the nose collar, grease packed in the ball groove and the balls put in place. The flat washer is threaded over on top of them, and insulating tape is wrapped round the mandrel behind it to hold it there. The mandrel can now be handled normally as if a caged bearing were involved and, as it is threaded through its bearings, into place, the tape is unwound just before entering the seating, the back washer being steadied with the fingers meanwhile. The mandrel bearings are plain parallel bronze bushes, split at one side as is their housing. Adjustment is by taking up the spring in the housing casting by a screw through the split. The mandrel is 1 in. diameter, to which bore the cone pulley had to be machined.

A belt tension limiter may be seen in the stand tray rim. This is just a $\frac{1}{4}$ in. hook bolt rod, hooked under one of the motor foot support straps. By adjusting the nut seen, any degree of tension can be given to the mandrel drive belt, up to the full weight of motor and countershaft.

WITH THE CLUBS

The Bristol S.M.E.E.

The following meetings will be held at The Folk House, College Green, Bristol, 1, at 7.30 p.m.

February 6th. Saturday. Film show, when we hope to show you some more films of engineering interest.

February 17th. Wednesday. "Bits and Pieces." Will you please bring along your current work and tell us all about it.

Hon. Secretary: W. E. ROUND, 14, Britannia Road, Kingswood, Bristol.

Worcester M.E.S.

We had a quite good attendance at the extraordinary general meeting held in December; one or two new members have joined, and several enquiries regarding the society have been made.

We have arranged the following programme for the next two months.

Thursday, February 4th. Lecture on pattern-making.

Thursday, March 4th. Demonstration of brazing of non-ferreous metals.

Hon. Secretary: F. L. FUDGER, 23, Camp Hill Road, Battenhall, Worcester.

Tees-side S.M.E.E.

At a meeting held at the Temperance Institute, Woodlands Road, Middlesbrough, recently, a talk was given by Mr. Graham, of the Erimus Research Group, on the subject of "Trick Photography." The speaker is a master of his subject and dealt with such matters as the photography of the growth of a flower, the "Match box" trick, the magic carpet, and many other unusual aspects of photography.

The programme of events for early 1954 includes the following:—

February 3rd. A "Bits and Pieces" meeting.

February 17th. Talk on "Grandfather Clocks," by Mr. T. H. Cummins,

Hon. Secretary: J. W. CARTER, 28, East Avenue, Billingham, Co. Durham.

CONDITIONS OF SALE

This periodical is sold subject to the following conditions, namely, that it shall not, without the written permission of the publishers first given, be lent, resold, hired-out or otherwise disposed of by way of trade except at the full retail price of 9d., and that it shall not be lent, resold, hired-out or otherwise disposed of in a mutliated condition or in any unauthorised cover by way of trade; or affixed to or as part of any publication or advertising, literary or pictorial matter whatsoever.

COPYRIGHT

All rights in this issue of THE MODEL ENGINEER are strictly reserved. No part of the contents may be reproduced in any form without the permission of the publishers.

CORRESPONDENCE

The Managing Editor invites correspondence and original contributions on all small power engineering and electrical subjects. Correspondence and manuscripts should not be addressed to individuals, but to the Managing Editor, THE MODEL ENGINEER, 19-20, Noel Street, London, W.1.

SUBSCRIPTION RATE

The Annual Subscription is £2 2s. 0d. post free, to all parts of the world.

THE MODEL ENGINEER

CLASSIFIED ADVERTISEMENTS

- PRIVATE RATE **3d.** A WORD
- TRADE RATE **6d.** A WORD
- MINIMUM 12 WORDS
- BOX NUMBER 1/- EXTRA

To "THE MODEL ENGINEER" Classified Advertisement Dept., 19-20, Noel Street, London, W.1.

Please insert the advertisement below under

heading.....for.....insertions

Name .....

Address .....

Three insertions for the price of two. ★ Private advertisers only.

Please write in block letters. REMITTANCE VALUE ..... ENCLOSED